GAS JOURNAL

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RESULTS OF CLEAVAGE

IN these columns a month ago ("JOURNAL" of August 13) we referred to the fact that to-day coke ovens supply some 12% of the gas supplied (if permitted) to the community, and we suggested that in the national interest the percentage of total supply should be increased in the next five years to 20%. At the same time we emphasized that coke ovens which are supplying gas to gas undertakings—the latter having statutory obligations of no mean order—should come, with the gas undertakings, under one jurisdiction. We are certain that manufacture and supply of gas cannot be separated without loss of efficiency and without damage to the service rendered; yet we stand to-day in the illogical position that while the Gas Industry remains un-nationalized —and we are not arguing the pros and cons of nationalization—a large proportion of the gas it supplies to the public is manufactured in coke ovens which are nationalized and which, for no good reason known to us, are ruled by the National Coal Board and serve under its singularly unhappy flag. The whole question of the manufacture by coke ovens of gas for public supply via gas undertakings should be considered far more seriously than hitherto in high quarters; so far it has had all too scanty attention in such quarters, perhaps largely due to apathy to and ignorance of facts. Gas undertakings taking coke oven gas cannot control the coke oven gas supply. Gas undertakings cannot plan the maintenance and repair programme of coke oven plant; they cannot make provision for the necessary supply of coke oven gas to meet peak demands. And the public suffers: there is no doubt about this. It is essential that supply and manufacture of gas should be operated under one control. Control of supply must not be divorced from control of manufacture. In dismissing this axiom of service to the community the Ministry of Fuel and Power show lack of perception and also show weakness—altogether, as we have said, to the detriment of the community.

Why is it that the Ministry of Fuel and Power seemingly takes no steps to ensure that coke ovens suppying gas, via gas undertakings, to the public have an adequate storage of coal to alleviate the effects of strikes and the like which are symptomatic of Britain's spirit to-day? Immediately behind us is the coal strike in Yorkshire, or at any rate, an important part of the Yorkshire coalfield, brought about through "sympathy" with the strikers at the Grimethorpe Colliery—a dispute as serious in its effect upon the coal position as were the wintry conditions at the beginning of the year. And before this dispute, industrial disputes caused, between January and July, 680 stoppages in the coal mines; coal mining accounted for more than half the total number of industrial disputes. In July alone, under nationalization, 27,000 working days were lost in the mines. The foregoing figures can be checked-up in the Ministry of Labour Gazette for August, which also records a larger aggregate increase in weekly wage rates than for some months. But our point here is that the Grimethorpe affair and its consequences resulted in the Coal Board issuing instructions to four carbonization plants supplying gas to the West Riding group of gas companies to reduce their output by 45%—a decision affecting at once 3,000 industrial and more than 100,000 domestic gas consumers and leading to short-time working in the steel, woollen, brick, and many other industries over a wide area. The Sheffield Gas Company had to ask large industrial users to cut down consumption of gas drastically; 120 of the largest firms in the Sheffield area had to be asked to cease using gas completely for industrial purposes. Is this the road to recovery? Does such a situation point to the peril of divorcing from gas undertakings all control over coke ovens supplying gas to those undertakings?

EDUCATION FOR SALESMANSHIP AND SERVICE

IN January of 1944 a special committee of the B.C.G.A. was set up by the Executive Committee to study the problem of gas service recruitment and training. The committee issued its report in October of the same year. Examination of the report and its acceptance by the British Gas Council in April, 1945, has now resulted in the issue by the Institution's Education Committee of Regulations and Syllabuses for the Certificate in Gas Salesmanship and Consumer Service. These are ambitious enough, but they are accompanied by no indication of any financial reward or enhanced status which the student may achieve after several years of serious study and they come at a time when salesmanship, unfortunately, is still in reverse. This does not, of course, detract from the theoretical merits of the scheme and no doubt if and when better times arrive, it will prove

extremely useful, especially if in a nationalized industry there is room for some sort of free competition between different forms of fuel service. In any case good gas service is impossible of attainment without a measure of technical training, and such training is predominant in the course of instruction.

It is good to note that in the very first paragraph it is laid down that a salesman must be able to speak and write good English in addition to having suitable personal qualities. This insistence on a high standard of English, a practised facility in expression, should be kept up through all our education schemes. In every homework exercise the English should be constantly scrutinized and progress insisted on. The standard and type of English required is set out in the phrase, "the use of the language as a means of communication." The oral examination, an integral part of the scheme, will provide the opportunity of seeing whether the candidate can use his native tongue to state a case pleasantly, accurately, and effectively.

The course of instruction is designed to cover three years part-time evening classes. These will be presumably the first three years of apprenticeship and it is to be hoped that the alternative of the part-time day course, which generally means one day per week at school with homework in the evenings, will be generally arranged for. The course itself, a foundation of elementary mathematics, engineering, science and drawing with a superstructure of gas supply and the principles of salesmanship, appears to be satisfactory.

At first sight it would seem that the knowledge required of a good general salesman is so encyclopedic that it is hardly to be acquired in a limited number of lectures. Only the principles can be taught. The practice must be cultivated in the school of experience. In the series of lectures at the Commercial Gas School in the U.S.A., to which we referred recently—and which dealt with only one sphere of gas service—much stress was laid on a sound and detailed knowledge of the market. A survey of the prospects, a knowledge of the part played by heat in a very large number of processes, a knowledge of the terminology of the several trades are preliminary to an acquaintance with the personalities, the relative positions and degrees of influence of the possible buyers—all this must be backed by a combination of confidence, industry, determination, and enthusiasm which in its perfection will be rare in the finished salesman. Unless its development is fostered by encouragement, by the provision of adequate scope and, it must be added, by sufficient incentive, no amount of education and training is likely to be successful. No doubt the most progressive undertakings have all this in mind and are doing what can be done in that direction. It will be some time, however, before the general scheme can be effective over the whole Industry. And it is important that it should be so widespread, for salesmanship in one district may be seriously hampered by the bad reputation which gas may suffer from in an adjoining district.

Gas, as a whole, has still to be lifted out of a certain out-of-dateness into a position where it can compete with the glamour of the "new thing." The general adoption of this scheme, adequately supported by the leaders of the Industry, should go a long way towards the goal.

TWO PRACTICAL PROBLEMS

THE two Papers presented to the North British Association on Thursday last are just two examples of the multifarious tasks which fall to the gas engineer—one on the Supply side and the other on the Manufacturing side of the Industry.

It is interesting to compare Mr. Fulton's experience with the conversion to gas firing of a steam-tube type baker's oven at Dumbarton with Mr. Johnson's and his colleague's experience in Wandsworth (I.G.E. Comm. No. 297/1946). In the first place the gas consumptions per sack of flour are substantially equal. Mr. Fulton does the job in one instance for 3.03 therms while Mr. Johnson found the average consumption ranged from 2 to 3.5 according to size and usage. Bread baking is a basic industry of considerable importance and the potential market for gas is worth consideration. It is deduced from Mr. A. E. Livett's Paper of January, 1946 ("JOURNAL" of January 23, 1946), that it may amount to 5% of all gas sales, while on the basis of Mr. Johnson's figure of 1.68 therms per head per year it might exceed 6%.

It may be questioned whether the conversion of ovens of existing types to gas-firing represents the best that gas can do. It is probably true that, as things are, there is not any alternative, on the big scale, to conversion. We cannot face, in the present shortage of materials and labour, a policy of wholesale scrapping and rebuilding. Conversion of existing ovens is, therefore, of great importance and the results may be regarded as satisfactory. But a thermal efficiency of 26.4% must not be accepted as the last word. It would be interesting to know whether the travelling oven, patented, says Mr. Fulton, as long ago as 1810, "the goods being placed on an endless band of wire cloth passing over suitable placed rollers"—the modern equivalent would be the steel band conveyor—does not give a substantially higher thermal efficiency. At any rate this principle, now being applied so widely in the ceramic industry, would seem to be that which takes the greatest possible advantage of the facility of precision regulating and control which is the most valuable characteristic of gaseous fuel.

But even with the handicap of application to an oven not specifically designed for it gas effects substantial savings in overall cost of bread production on the familiar lines of the elimination of costs of stoking and transport of solid fuel and its accompanying ashes, increased life of the oven due to the use of clean fuel, the facility of automatic control reducing wasters and supervision, and finally the marked improvement, so important in the preparation of any kind of food, in the cleanliness and general hygienic conditions of the bake-house.

The other problem was of a totally different character. A giant gasholder, of 7 million cu. ft. capacity, may go on breathing up and down, needing very little attention beyond painting, for 45 years. But there comes a time when defects appear. Leakages begin to occur in places which are not readily accessible—*e.g.*, in the cups and from the seams and joints in their vicinity. The lifts do not land evenly owing to accumulation of foreign matter deep down in the bottom of the tank. More accessible are the pins and bushes of the guide rollers which require renewal or repair. And even the bolts attaching the "crown and thistle" finials which "ornament" the tops of the standards begin to waste away!

It was a major operation—a big job—and the assistance of specialists, who deal with many such cases in the course of their business, was wisely invoked. "Much ingenuity was displayed . . . in overcoming the difficulties, and in carrying out the work under most unpleasant and disagreeable conditions." That is the way—the English way—of describing the skill and care, the downright heroism, with which this operation, and others like it, are carried out by the technicians of the Gas Industry. There is the care in the dangerous operation of purging the holder crown, when a slip would create an explosive mixture with possible disaster not only to themselves but also to others. There is the descent of the one pipe, crawling along the other, climbing up a third to the interior, with telephones, flameproof and of the mining type, with rescue harnesses and white mice. And then the raising of the lift clear of the cup to get at the bolts. And finally, the following year, the divers getting at the sludge and debris at the bottom of the tank, an operation taking 3½ months in all. It reads like the great adventure it was and while we learn what we can, we congratulate all those engaged in it and above all those responsible for planning it and watching over it, on the successful conclusion of a very fine piece of work—just "Repairs to a large gasholder."

NEW COALFIELDS

During a meeting of the Geology Section of the British Association it was stated that supplies of coal, at least enough for 200 years, at present rates of consumption, are in sight—and this applies not only to total supplies but also to supplies of each particular kind. Professor H. G. A. Hickling explained that as deeper and deeper seams are worked the coal becomes, on the whole, better and better. "We can," he said, expect from the deeper seams of the future an increasing quantity of good coking coals." Dr. G. M. Lees, Chief Geologist of the Anglo-Iranian Oil Company, said that so far a new coalfield had been found at a depth of 5,000 ft. in Lincolnshire, and there was good prospect that other fields would not be so deep in the vicinity of the Wash. There were, he added, indications that new fields might exist near Market Drayton, in Shropshire, in Wiltshire, in the Cotswolds, possibly between Oxford and Reading, and in Eastern Essex. Oil explorations have revealed how limited the knowledge of our coal resources still is and how limited are the older methods of exploration. Discussing coal as a raw material for the chemical industry, Dr. R. Holroyd remarked that, although in the past the industry had provided an outlet for the by-products of carbonization, present demands greatly exceed supply.

Commentary by "Abaris"

Communal Laundries

The London County Council plans to equip all its blocks of flats with communal laundries, if we are to believe a report that we read recently in a Sunday newspaper. This, said the reporter, will result in a saving of fuel and drudgery. Gas and electricity companies are putting up competitive schemes for the new installations that will wash, but not dry out and iron, the clothing brought in by housewives.

This type of service has a number of virtues, but I reckon that a good deal of propaganda will be necessary to popularize these laundries in the London area. Few women, if any, like loading themselves up with a hefty weekly wash and to walk thus equipped past the noses of their neighbours, for a mile or two to the hot water and tub-house.

Nevertheless we must view the move towards communal wash houses with anything but a complacent eye, for such a development will mean a loss of some of our load. First, because many local authorities run their own electricity undertakings, and will see, therefore, that electricity is the heating medium; and, secondly, because it takes the women out of their homes, where they should be burning gas in their own ways. They should be putting pennies in their meters and adding directly to our revenues.

The London County Council proposes to charge a shilling a time, and this sounds rather expensive, for few women put that much in their meters, for one washing. At least not with a gas wash copper. What with communal feeding and communal washing, kitchens will soon be a thing of the past, if we go along with all this communal servicing. No one will deny that organization is a good thing: but over-organization is not, particularly at the ratepayers' expense.

It seems that the individual is gradually to be submerged in the sea-tide of State or borough enterprise. The loss of individuality is a long step towards decay, and more's the pity. The least that can be said for private enterprise is that it does treat the person as a living, thinking individual; not as an animated eating machine.

That Stint

English is a peculiar language. There are many words each spelt in the same way, but having very different meanings; indeed, many words are frequently so badly spelled as to be quite unrecognizable, regardless of their particular meanings. We must blame Old English, German, French, Italian, Latin, and Greek, among others, for our philological difficulties.

That simple little word "left" may mean "remainder" or it may have a political implication; "strike" may mean hit, light a match, or down tools and stop work.

"Stint" is another such curiosity, for the stint is a bird; at the same time it means to limit output, limit effort, or to curtail supplies. By a strange contemporaneous coincidence, the word describes a task that a miner must do in a given time; it is a technical version, roughly, of piece-work. Frequently the miner finishes his stint well within his shift period; this done, he is free to go home and cultivate his mind in the study of Tolstoy, Turgenev, or the consideration of canine form.

This stint confusion caused the Grimethorpe strike and subsequent additions to the movement away from other pits; a concession by the miners in working a larger stint would have been tantamount to inviting other concessions, so they argued.

There must be a small, or large, extremist element in the coal business who are persuasive enough to lead disgruntled miners easily, in the wrong direction. But at the same time I do not think that the miners generally have taken kindly to the new bureaucracy that waves its flags over all its premises. I feel vastly put out, for the mines are mine, yet I cannot have my say in their management; they are yours, too, and you are silent.

Fuel Efficiency

A blithesome holiday spirit has lately seized me, so in order to bring myself back to earth, I decided to look at *Fuel Efficiency News* for August. I cannot quote from the document because I must first of all ask the Stationery Office for permission, and as I do not like talking to the Stationery Office, I am afraid that you will have to forego the perusal of some additional, stodgy English.

With this issue of *F.E.N.* came another publication entitled "The Handling and Storage of Coal," Fuel Efficiency Bulletin No. 49. Yes, 48 others preceded this one: each is issued gratis; each had a circulation of about 50,000; and each had an average of 16 pages. The hollow talk about paper shortage is never breathed in the purlieus of the Ministries; and the Stationery Office, whose mighty presses are fed so lavishly, have still to feel the pinch that affects all normal printing.

What man-power is used up in the production of this stuff is never likely to be revealed, but the man-hours required by the outside readers must be considerable. By the time one has reached the end of the second paragraph, one has to run to the dictionary to find out what really is the definition of efficiency. One ought, I suppose, to read the long-winded pages with care and patience, but the writing reminds me rather of school essays.

As far as these publications go, there is no justification for so much material that is vapid, verbose, and valueless; but this is a sign of the times, for we must guard against being the butt of all the pamphlets, booklets, sermons, and other bits and pieces of Government foodstuffs.

Austerity ought to begin at home; so should efficiency.

Ymweliad Cymru a Llundain

Our friends in Wales will recognize the title in a trice, and it means Wales comes to London. Wales came to the Metropolis and occupied the Empire Hall at Olympia from Aug. 28 to Sept. 13, where there was staged a very good show. I am not quite sure whether the exhibition was intended to attract industries to Wales, or whether it was intended to show Londoners what the Principality does. Possibly it was both.

The National Coal Board let itself go, financially, and had an impressive exhibit that would have rocked the Chancellor of the Exchequer somewhat. Somehow I feel that there is far too much formality in these national efforts. It would be almost unfair to pick out individual firms, but I am going to nevertheless, for it would pay exhibition authorities in the Gas Industry to have a round of these great bodies.

Imperial Chemical Industries had, for them, a small space and the usual gamut of pawnbrokers' symbols hanging by ropes, wire and what have you, in one of their famous cones. But the individual parts of the stand were educative. Monsanto, another great chemical company, showed how their products found uses in home, hospital, and industry. The stand contained a number of photographs, well mounted and well captioned. It was a display for the layman, built understandingly, neatly; but never a sign that most of their products came from the carbonization of coal and the coking industry. The British Electrical Development Association, too, was conspicuous, at least to a gasman, but it was no world beating stand; far from it.

Frankly, I was disappointed by the British Gas Council exhibit, which had most of the lesser virtues of an effort in the Ideal Homes Exhibition. There was no single line or word to tie up gas with Wales, which, as Mr. Gladstone would have said, is incomprehensible. Neither was there an indication of the important fact that the Gas Industry is part of this country's chemical industry. Our by-products story was a *non est*; but joy of joys, there was on the stand a small water pistol and a tiny box of some of those undersized cigars that one gives to the unwelcome guest in one's home.

The exhibition was not too well patronized by the public, for there was a rival attraction elsewhere in the enormity of Olympia; Londoners are very self-centred, too. But Wales or no Wales; Londoners or no Londoners, our Industry has a magnificent story, which we always appear to recount, or display, sheepishly.

Personal

Mr. A. R. BISSETT, Engineer and Manager to the Douglas Gas Light Company, has been appointed a Justice of the Peace for the Isle of Man.

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Mr. WILLIAM A. WOOSNAM, of the Milford Haven U.D.C. Gas Department, has been appointed Gas Manager to the Rothwell (Northants) U.D.C.

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Mr. J. G. BRANSON has resigned his position as Engineer and Manager of the Swadlincote Gas Department consequent upon his being appointed to a similar position with the Sidmouth Gas Department.

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Mr. FREDERICK BELL and Mr. JOHN E. POWERS, Distributing Engineer and Office Comptroller respectively in the Liverpool Gas Company, sailed in the *Mauretania* for New York on Sept. 2. Their brief is to gather details of gas problems in the U.S.A. which were noted by Mr. C. H. Leach on his visit to the States last year.

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The wedding of Mr. DOUGLAS MARTIN, younger son of Mr. and Mrs. G. W. Martin, of East Herrington, Sunderland, with Miss Brenda Rostron, second daughter of Mr. and Mrs. R. H. Rostron, of Shaw, Lancs, took place on Sept. 3, at the Parish Church, East Crompton. Lancs. Mr. G. W. MARTIN is Manager of the Houghton-le-Spring District Gas Company.

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Mr. GEORGE COBB has been appointed Technical Assistant to th Johnstone Gas Department. A native of Montrose, he was educated at the Academy there and trained on the works of the Montrose Gas Company. He studied at Dundee Technical College and gained the Certificate of Gas Engineering (Manufacture) with distinction, and also (Supply). He served for five years with the R.A.F. and on demobilization attended Bradford Technical College, gaining the Higher Grade Certificate in Gas Engineering (Manufacture).

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Councillor BERNARD CLARKE, Engineer, Manager and Secretary of the Stamford and St. Martin's Gaslight and Coke Company, and also since 1937 a member of the Board of Directors, has been chosen as Mayor of Stamford for the coming mayoral year. He has taken a great part in the town's affairs since he went there from Long Eaton, Notts, where he was Assistant Engineer and Manager of the Long Eaton Gas Company, and he has been a magistrate since 1942. In 1935 he was President of the Eastern Counties Gas Managers Association, and in addition to having served on the Council of the Institution of Gas Engineers, he is also a member of the central executive of the British Gas Council and of the central committee of the Federation of Gas Employers.

News in Brief

Organized by the Office Appliances Trades Association of Great Britain and Ireland, the Business Efficiency Exhibition will be held in the Empire Hall, Olympia, from Oct. 1 to 11.

Hamilton, in the heart of Lanarkshire's rich coal mining area, is to receive 200 tons of American coal. It has been agreed by Hamilton Town Council to recommend the Gas Department to take over this amount.

Dingwall Town Council have approved a proposal by the Gas Committee to carry out improvements to the gas-works at a cost of between £14,000 and £16,000. This will include the erection of a new gasholder, installation of six retorts, condenser, exhauster, scrubber, and re-sheeting the covers of the purifiers.

The Cambridge University and Town Gas Light Company has been authorized by the Ministry of Fuel and Power to proceed with the laying of 2,400 yards of 20-in. diameter low pressure trunk main at an estimated cost of £18,500. This section of main is part of a comprehensive five-year plan (since reduced to a three-year plan because of extensive housing development) of mains extensions, some of which have been completed or commenced.

The Seventh Series of Post-Graduate Lectures organized by the Oil and Colour Chemists' Association (London Section) on Oct. 2, 9, and 16, at 6.30 p.m., in the Lecture Theatre of the Royal Institution by Sir. W. Lawrence Bragg, the subject being "A Review of Recent Advances in X-Ray Analysis." An inclusive charge of 10s. for the three lectures will be made to members and visitors, and applications for tickets should be made to Mr. H. C. Worsdall, c/o Messrs. Plastanol, Ltd., Crabtree Manorway, Belvedere, Kent.

A Week's Course for Home Service Advisers has been organized by the British Gas Council and is to be held, by courtesy of the Gas Light and Coke Company, at the Domestic Centre, Watson House, starting on Sept. 22. This is the third of these courses, and it is hoped to hold a fourth in October.

In the Report for the year ended May 15, it was stated by the Dunfermline Gas Department that 42,808 tons of coal were carbonized and 715,174,000 cu.ft. of gas were manufactured, an increase of 60,584,000 cu.ft., equal to 9.25% compared with the previous year. The maximum consumption of gas over a period of 24 hours was 2,688,000 cu.ft. on Dec. 31, 1946.

The Trade Statistics for May, 1947, just issued by the Department of Industry and Commerce in Eire, show imports of 6,728 tons of gas coal, valued at £20,322, as against 26,492 tons, valued at £78,263 in May, 1946. This brings the total of these imports for the first five months of 1947 to 31,446 tons, valued at £95,610, compared with 97,334 tons, valued at £279,660, in the corresponding period of 1946.

A Correction.—In last week's "JOURNAL," p. 559, there was a paragraph in our "News in Brief" indicating that the Glasgow Gas Department had entered into an arrangement to purchase from Geo. Waller & Son, Ltd., a compressor in connexion with the coke oven gas supply being received from Bairds and Scottish Steel, Ltd. In point of fact the matter is yet under consideration by the Gas Committee.

The Wales and Monmouthshire Association of Gas Engineers and Managers will hold a general meeting at Llandrindod Wells on Tuesday, Sept. 30, and Wednesday, Oct. 1. On the Tuesday there will be Golf and Bowls Competitions, and the meeting will take place at the Glen Usk Hotel at 10 a.m., on Oct. 1, followed by an Official Luncheon at 1.15 p.m. A visit to Elan Valley Water-works has been arranged for the afternoon.

Less Than a Fortnight after the announcement in the U.S. Press of the British Export Trade Research Organization's Washington office's new service to help American importers find British sources for the goods they want, nearly 100 important trade enquiries have been received at B.E.T.R.O. in London and forwarded to the members most likely to be interested. Already 200 British manufacturers have submitted their American export problems, and on Sept. 15, Time Incorporated, through "The Merchandizing Group," which has representatives in 55 cities and towns across the United States, will start finding out the answers.

Diary

Sept. 18.—Industria' Gas Development Committee, South Metropolitan Gas Company's Offices.

Sept. 18.—Midland Counties Coke Association: Central Committee, King Edward House, Birmingham, 2.30 p.m.

Sept. 20.—Manchester and District Junior Gas Association: Extraordinary General Meeting, Gas Showrooms, Manchester, 2.30 p.m.

Sept. 23.—Midland Junior Gas Association: Joint Meeting with Midlands District Gas Salesmen's Circle for Annual President's and Chairman's Day, Birmingham.

Sept. 24.—Eastern Junior Gas Association : Meeting at Lincoln.

Sept. 24-25.—Institute of Statutory Inspectors of Gas Meters: Annual Conference, Royal Pavilion, Brighton. "History and Development of Wet Meters," B. R. Parkinson; "Gas Meters in the British Zone of Germany and in Berlin," M. W. Jones (Gas Testing Branch, Ministry of Fuel and Power).

Sept. 26.—North of England Gas Managers' Association (Auxiliary Section): Autumn Meeting, visit to Monkton Coke and Gas-works.

Oct. 1.—B. G. C. Domestic Development Committee, Gas Industry House, 10.30 a.m.

Oct. 1.—Wales and Monmouthshire Association of Gas Engineers and Managers : General Meeting, Llandrindod Wells (preceded on Sept. 30 by Golf Competition on Llandrindod Wells Golf Course).

Oct. 2.—Solid Smokeless Fuels Federation : Executive Committee Dorchester Hotel, Park Lane, W.1., 11.30 a.m.

Oct. 16.—Institute of Fuel: Melchett Lecture by Major Kenneth Gordon, C.B.E., "Hydrogenation in the Fuel and Chemical Industries." Gas Industry House, 2.30 p.m.

Oct. 20.—London and Counties Coke Association: Annual Luncheon 1 for 1.15 p.m.; Annual General Meeting, 2.45 p.m. Grosvenor House, Park Lane, W.1.

Oct. 25.—Yorkshire Junior Gas Association : Annual General Meeting, Royal Victoria Hotel, Sheffield, 2.30 p.m.

Oct. 28.—Southern Association of Gas Engineers and Managers: Annual General Meeting, Connaught Rooms, Kingsway, London. 2.30 p.m. (Preceded by Council Meeting, 11 a.m.; Luncheon, 1 p.m.)

Nov. 25-26.—Institution of Gas Engineers : 13th Autumn Research Meeting, London.

RECENT DEVELOPMENTS IN GASIFICATION

William Young Memorial Lecture*

By Dr. D. T. A. TOWNEND

Director, British Coal Utilization Research Association

I am honoured to be invited to give this William Young Memorial Lecture, not only because it marks an important and distinctive event within the activities of your Association, but because it perpetuates the memory of one described by Dr. Alfred Daniell in his "Appreciation" introducing the first lecture—which was given by Dr. H. G. Colman in 1912—as "a pioneer in a double sense: for not merely was he an inventor in the practical arts, but he was equally a pioneer in the continuous application of the scientific point of view to the problems which his inventions were intended to solve." Daniell went on to point out that while science is one and undivided, there are two distinct sides from which the laws of the physical universe may be approached—the purely intellectual and the purely practical; the enquirer who studies these laws for the sake of intellectual satisfaction is certainly free from limitations and entanglements which hamper the enquirer who desires to *know* in order that he may *apply* his knowledge, but the critical attitude of pure knowledge by itself can be fatal to the building-up either of new knowledge or of new inventions.

There can be little doubt that William Young possessed the double faculty. He displayed the additional "something" that raised him above practical affairs to the level of the scientist with attendant ability to experiment, understand, interpret, and enunciate theory; thus Daniell: "had the early life of William Young been cast amid intellectual surroundings, he would have won for himself the highest recognition as a pioneer in science, and his name would to-day have been enrolled among the illustrious men of science of our time."

Had William Young survived a further year or two, I think he would have seen much fulfilled which was near to his heart in the establishment of the Livesey Chair at Leeds University (1910). This instituted not only a University training ground for students in gas engineering but a live partnership between the University and the Industry which has been so much to the great advantage of both during the 37 years that have ensued. It is because of the eight most happy years before 1946 which were my own privilege in this appointment that I value this opportunity of referring to some of the work done there; and it is the more pleasing to me as I note that my predecessors at Leeds, Professor W. A. Bone (1908-1912)—under whom it was also my own privilege to serve during some 18 years at the Imperial College of Science and Technology, London—and Professor J. W. Cobb (1912-1938) have also been William Young Memorial Lecturers.

Some 40 years ago Great Britain was depending more than the newer industrial countries upon the staple industries in which she had specialized for more than a century; but in many instances plant was becoming obsolete and inefficient and below the standards which scientific knowledge could furnish. A new spirit was abroad, however, an illustration being the frequently quoted passage from the Charter of the Imperial College (1907): "To give the highest specialized instruction and to provide the fullest equipment for the most advanced training and research in various branches of science, especially in its application to industry." I think we probably owe the establishment of the Livesey Chair at Leeds most to Professor Smithells, who firmly believed that "Science has its roots and has gained its greatest impulse in the avocation of men"† and had for many years found interests and close friends within the Gas Industry. Since 1910 many outstanding figures whose names are household words within the Gas Industry have received their training or research experience at Leeds; to-day I would direct your attention more particularly in the direction of research achievement.

In 1909 the Joint Research Committee of the Institution of Gas Engineers and the University was set up for the investigation of "gas heating" problems; the First Report of the Committee gave an account of work by Dr. (now Sir) E. W. Smith on "The Production and Application of a Method of Conveniently Measuring the Radiation Influence of a Gas Fire." Except for a break during the First World War, this Joint Committee has continued ever since, but with description, composition, and subjects varying from time to time. The work controlled by the Committee has covered a wide range of problems of manufacture and utilization directed to answer questions of immediate importance to the Industry; many of the results have been translated into standard practice. The Committee is now the Joint Research Committee of Leeds University and the Gas Research Board, and succeeding Chairmen have been Professor A. Smithells, Mr. T. Hardie, Dr. E. V. Evans, Dr. H. Hollings, and now Mr. J. E. Davis. Mention should also be made of the Gas Research Fellowship instituted at the same time by the Institution of Gas Engineers; and many Fellows have subsequently had distinguished careers.

Among the subjects studied under the Joint Committee, special mention attaches to (*a*) the performance of newer systems of carbonization; (*b*) the performance of different grades of gas in use, the early work providing a technical basis for the Gas Regulation Act, 1920; (*c*) steaming in continuous vertical retorts; (*d*) the influence of alkalis on the re-activity of coke; (*e*) the efficiency of water gas plant; (*f*) combustion characteristics of town gas supplies; (*g*) the possible applications of infra-red radiation in drying, &c., processes. When in the early 30's news reached this country from the Continent of the new developments in complete high pressure gasification of lignites, the Committee—then under Dr. E. V. Evans's Chairmanship—at once initiated research into this field, having in mind the possible application of this method of complete gasification to a wide range of the bituminous coals, not necessarily gas-making coals, available in this country.

It would be beyond the ambit of this Lecture to consider all the researches enumerated above, but it is to the last mentioned field, so brilliantly set in motion by Dr. F. J. Dent and his co-workers, that, on the suggestion of your President, I particularly wish to refer to-day. It is attracting great interest at the present time now that, through B.I.O.S. and other Reports more details of recent developments in Germany have reached this country; and I will discuss these developments insofar as time will allow.

The Industrial Application of Chemical Thermo-Dynamics

Here I would digress for a moment to stress the great importance attaching to the part played by scientific knowledge in the development of industrial processes; and having in mind the subject of this Lecture, my special theme would be the vast developments which have followed Le Chatelier's enunciation in 1888 of the principle of mobile equilibrium in reversible systems. It is interesting to note in passing that many advances in pure science have been the outcome of investigations into industrial problems, and the Le Chatelier principle arose from his investigations on cements.

In gasification processes, the composition of the gaseous products is controlled, or at least greatly influenced, by the operation of well-known reversible systems such as:

(1) $2CO \rightleftarrows C + CO_2 + 41$ K.C.U.

(2) $CO + H_2O \rightleftarrows CO_2 + H_2 + 10$ K.C.U.

(3) $CO + 3H_2 \rightleftarrows CH_4 + H_2O + 58$ K.C.U.

The Le Chatelier principle states that in such systems any change in the factors of equilibrium (*e.g.*, concentration, pressure, and temperature) from the outside must be followed by a reverse change within the system. Thus, for example, (*a*) as any change in the direction $2CO = C + CO_2$ is accompanied by a decrease in volume, an increase in pressure at any given temperature will cause a decrease in the "equilibrium" proportion of carbon monoxide, and *vice versa*; ialso (*b*) as any change in the said direction must be exothermic, an increase in temperature at any given pressure will cause an increase in the "equilibrium" proportion of carbon monoxide.

Perhaps the most outstanding application of this principle was Haber's synthesis of ammonia about 1910 by means of the system $N_2 + 3H_2 \rightleftarrows 2NH_3 + 24$ K.C.U.; the process depends upon suitable catalysts to speed reaction, high pressure to increase the yield of ammonia, a sufficiently high temperature to favour reaction velocity but not high enough to throw the reaction in the reverse direction. Another example of the same period is the synthesis of nitric oxide by means of the reaction $N_2 + O_2 \rightleftarrows 2NO - 43$ K.C.U.; in this instance pressure is of no advantage on the yield which is, however favoured by high working temperature; thus the Birkeland-Eyd

* Given to the North British Association of Gas Engineers, St. Andrews, Sept. 11.

† "The Modern University," by Professor Arthur Smithells.

process, in which the synthesis is effected by means of a spark discharge, rapid cooling being essential to avoid decomposition and loss of yield during the cooling period.

It is an interesting reflection that just as achievement of the ammonia synthesis rendered Germany less dependent on imported nitrates for explosives manufacture immediately prior to the First World War, so the more recent hydrogenation and Fischer-Tropsch processes, which employ the same principle, rendered her less dependent on external liquid fuel supplies before the Second World War. Other particularly interesting applications are (*a*) the use of pressure in the Lurgi gasification process intended for the purpose of methane synthesis, according to reaction (3) above—and with which I shall deal at some length—and (*b*) the synthesis of acetylene, an important starting material for a wide range of chemicals, by the quenching with water of methane-oxygen flames, thus making use of the system $2C + H_2 \rightleftarrows C_2H_2 - 80$ K.C.U., a process analogous to the synthesis of nitric oxide in requiring a high temperature for yield followed by rapid chilling. One can elaborate this discussion with many further examples: thus the processes of hydrogenation, polymerization, aromatization, alkylation, &c., employed in the petroleum industry to-day for the production of synthetic liquid fuels; again, a limitation on flame temperature is imposed by the reversible decomposition of steam and carbon dioxide; and to-day the formation of oxygen and hydrogen atoms and free radicals by such systems as $H_2O \rightleftarrows H + OH$ is recognized as of technical importance. Lastly, the disadvantage exhibited by coal in comparison with petroleum as a source of synthetic chemicals is largely attributable to its aromatic structure contrasted with the paraffinic, olefinic, or naphthenic structure of petroleum hydrocarbons; for during its formation in geological time Nature has already expended pressure and temperature energy in rendering coal aromatic in character, and the economy of its reconversion into less condensed organic chemicals has, therefore, limitation.

I trust that my digression into this important field may be of advantage in considering the thermodynamic factors concerned in the gasification processes to which I will now refer.

Gasification Processes

There are two main methods of producing gaseous fuels—carbonization and gasification. When coal is carbonized the products are obtained in the solid, liquid, and gaseous states in amounts and chemical characteristics depending on the temperature employed. The coal is subjected to heat treatment within a vessel, the source of heat being applied externally; and because both coal and refractory materials (have low heat conductivity, the process is accompanied by a certain loss of fuel energy. Good practice to-day may attain an efficiency of 75%, and it may be doubted whether by current methods this is likely greatly to be exceeded.

Methods of internal heating, therefore, offer attractions, owing to the better conditions of heat transfer, and this is achieved in gasification processes by the internal oxidation of part of the charge itself. At present coal or coke may be gasified completely by means of the producer gas reaction, and coke (sometimes coal) by means of the water gas reaction, which proceed according to the equations shown below.

PRODUCER GAS REACTION

(1) $C + \frac{1}{2}(O_2 + 4N_2) = CO + 2N_2 + 29$ K.C.U.

WATER GAS REACTION

(2) $C + H_2O = CO + H_2 - 29$ K.C.U.

Also, (3) $C + 2H_2O = CO_2 + 2H_2 - 19$ K.C.U.

WATER GAS EQUILIBRIUM

(4) $CO + HO_2 \rightleftarrows CO_2 + H_2 + 10$ K.C.U.

METHANE EQUILIBRIUM (Pressure)

(5) $CO + 3H_2 \rightleftarrows CH_4 + H_2O + 58$ K.C.U.

(1) is the main producer gas reaction; (2) and (3) are the two steam reactions with carbon. While reaction (2) is predominant at temperatures of 1,000° C. and over, at temperatures of 500-600° C. reaction (3) predominates; and at intermediate temperatures both CO and CO_2 are formed. It is usual in producer gas practice to effect gasification by "blowing" the fuel with an air-steam blast so that both the exothermic oxidation and endothermic steam-reduction reactions proceed continuously. If raw coal is used, gasification is accompanied by its partial distillation, thus resulting in a producer gas of somewhat increased calorific value. In addition to the main reactions, consideration has to be given to the water gas equilibrium (4) and, when pressure is employed as in the Lurgi process, to the equilibria involving methane synthesis—*e.g.*, (5). Both such equilibria are established or nearly so as the gases leave the reaction zone.

As is well known, in producer gas practice the bed temperature must not be allowed to fall or the CO_2-content of the make becomes high; on the other hand this temperature must not reach the ash-fusion point or clinkering will result. The balance is effected by a correct steam content of the blast or steam saturation temperature. The use of steam also helps the calorific value of the "make" in that combustible water gas is produced, thus decreasing the nitrogen content.

In general, owing to its high nitrogen content (upwards of 50%), producer gas is of too low a grade to permit of economic distribution widely; moreover, the nitrogen increases the sensible heat loss in the flue gases when producer gas is burned. In the manufacture of water gas, the difficulty of nitrogen dilution is avoided by alternating the air "blow" with a separate steam "run" which gives the "make," thus enabling the production of a higher grade gas; this, however, is achieved at the sacrifice of a proportion of the available heat in the fuel, the loss being in the sensible heat of the blow gases. Possible improvements in the efficiency of producer gas practice can be effected by (i) heat recovery from the hot gases and return to the plant; thus, pre-heating the blast facilitates increased conversion of steam in the fuel bed, up to 400° C. being permissible; (ii) maintaining as low an oxygen-steam ratio as possible; and (iii) reducing other heat losses from the system.

Greater efficiency is obtained in the water gas process by using waste heat for the thermal decomposition of gas oil leading to the production of carburetted water gas, but a drawback is the necessity to use coke, as this involves the separate processes of carbonization and gasification, each accompanied by thermal loss. For this reason attempts have been made to combine both carbonization by waste heat and gasification in the same process. Illustrations are the Tully and the Broadhead systems; the Tully system provides a gas of 350 B.Th.U./cu.ft., and this value may be increased by carburetting.

The Newer German Processes

As indicated, gasification processes have the advantage of internal heating, but methods are necessary whereby fuel can be gasified in the raw state while at the same time avoiding a high nitrogen content in the gas produced, coupled with high conversion efficiency. Close attention has been given to the matter during the past 20 years in Germany for a number of reasons—principally (i) the need to utilize brown coals and lignites which cannot in any event be carbonized by normal practice; (ii) the need for synthesis gas (H_2—CO) mixtures for the production of liquid fuels and chemicals; and (iii) the availability of oxygen produced by more efficient methods.

I will confine this discussion mainly to the use of O_2 (or O_2—enriched air)—steam blasts, the typical processes being (*a*) the Lurgi-Drawe operating under pressure at the lowest reaction temperature consistent with fuel bed reactivity at 900-1,000° C.; (*b*) the Winkler operating at 1,000° C. with a "boiling" bed at atmospheric pressure; and (*c*) the Leuna-type and Thyssen-Galocsy slagging producers operating at a temperature as high as 1,600° C. with consequent removal of the ash in the form of a slag. The Lurgi and some slagging producers have fixed fuel beds, while the Winkler is the most developed example of a non-stationary fuel bed.

All these newer processes, even those which, like the Winkler and Lurgi, rapidly reached the full-scale industrial stage, have been very much on trial in regard to costs in competition with the traditional "blow" and "run" method of manufacturing water gas for synthesis gas. The cost of oxygen figured largely in the German cost estimates, but when the German costs and efficiencies are re-estimated for British conditions the cost of oxygen is not such a handicap, mainly because German fuel costs are low by our standards—Winkler coke breeze, for example, being debited at 1 Reichmark per ton—and also because of developments in the production of cheap industrial oxygen.

Other German processes are concerned with the use of either externally heated reaction chambers recovering waste heat or with the use of internal heating by a recirculation of hot gases. Brief reference will be made to the Pintsch-Hillebrand and Bubiag-Didier plants.

The Use of Oxygen at Atmospheric Pressure

When oxygen is used in place of air, the "blow" and "run" operations are combined by an oxygen-steam blast; this is the basis of the three processes enumerated. It is of great interest that the first recorded consideration of the possibility was a discussion by Hodsman and Cobb at Leeds University contributed to the Institution of Gas Engineers in 1921. These Authors considered that internal carbonization by oxygen alone would be unsatisfactory and that the hot gaseous products of combustion of a portion of the coke at the bottom of, say, a vertical retort would not be a suitable vehicle for the transfer of heat to the rest of the coke in order to complete the distillation of the coal; and further, if all the coke were sufficently heated, it would have to be discharged at a temperature too high to be economical or practical in a continuous process. Hodsman and Cobb formed the opinion, therefore, that for a successful process to work continuously, internal carbonization must be accompanied to some extent by a gasification process with steam, by which means heat would be extracted from the coke and a supply of water gas provided. From calculations made at the time, it was concluded that inevitable thermal losses in either carbonization or complete gasification of coal with steam and oxygen would be relatively small and the thermal efficiency correspondingly high. And carbonization with steaming would probably enable nearly one-third of the heat energy of the coal to be transposed into gas containing a small proportion of inerts and still leaving half of the original coal as coke. Were gasification taken to completion, after allowing for the steam, 90%

of the heat energy of the coal could be recovered, 86% in the form of gas of 352 B.Th.U./cu.ft. These assumptions were later tested by Vandaveer and Parr; but unfortunately only a small scale generator was employed using either oxygen alone or 50/50 oxygen-steam mixture. The tests were unsuccessful owing to the fall in temperature of the bed, with consequent decrease in gas quality.

An excellent general account of this field, together with the early German experiments which followed, was given by Dr. H. C. Millett, then working at Leeds University under the Joint Research Committee of Leeds University and the Institution of Gas Engineers, in the Journal of the Institute of Fuel, Vol. 10, 1936, p.15; and his Paper is well worthy of reference by anyone specially interested. A report of the first German experiments was published by Drawe in 1927. The trials were made with lignite briquettes, having in mind that their high volatile content would reduce the oxygen required: also, in order to obtain maximum steam decomposition, a deep fuel bed was employed. When "blowing" with a mixture containing a steam-oxygen ratio of 2.25, gas of gross calorific value 325 B.Th.U./cu.ft. was obtained without any sign of ash fusion, although these results were determined by the limited supply of oxygen available.

Little further immediate progress appears to have been made, no doubt on account of the cost of oxygen relative to the calorific value of the gas obtained. The interest of the Joint Research Committee was soon aroused, however, when accounts reached this country of experiments in Germany by the Lurgi Gesellschaft which indicated that when gasification was effected with a steam-oxygen blast *at pressures of* 20-30 *atmospheres* a gas of calorific value comparable with that of town gas was obtained after the removal of carbon dioxide. This development was coupled with that of the Linde Frankl process for oxygen production which greatly reduced its cost.

A picture of the possible value of this development to Great Britain was given in a Paper, "Considerations upon the Processing of Coal," by Dr. E. V. Evans, presented to the Institution of Gas Engineers in June, 1938.

The Lurgi Process

The development of the Lurgi process in Germany was at that time of particular importance to that country because of its large lignite deposits, having regard to its post World War I economy. Prior to 1914 gas-making coals had been available in the Ruhr Valley, Silesia, and in the Saar Valley, but much of the supplies for Northern Germany had been obtained from British sources. Under the Versailles Treaty, however, Germany lost the Saar coalfields, and monetary problems precluded the purchase of coal from abroad. The exploitation of the lignite deposits, therefore, became a major necessity.

While lignite can be gasified easily by established processes on account of its non-caking characteristics, it does not lend itself to treatment by carbonization, and while the synthesis of methane by means of the reaction $CO + 3H_2 \rightleftarrows CH_4 + H_2O$ had previously been proposed as a means of subsequently stepping up calorific value, the difficulty of finding a catalyst which would maintain reactivity with such commercial gases had hindered progress. Nonetheless, the incorporation of the synthesis reaction held attractions, an important one being that the employment of pressures above atmospheric would increase the yield of methane and still further enhance the calorific value of the product. It was impracticable to adapt the standard water gas process to pressure working and the Lurgi firm were quick to appreciate the possibility of a gasification process employing a steam-oxygen blast under pressure, evidently with the hope that the lignite residue would itself sufficiently catalyze the water gas conversion to methane.

Small scale experiments at once established the method, whether the fuel were lignite, anthracite, or semi-coke, and experiments at 1 and 18 atmospheres, respectively, increased the percentage of methane in the crude gas using semi-coke from 1.8 to 13.3%, or from 2.35 to 19.8% in the purified gas. The most interesting feature of this work, however, was the consistency of the results, irrespective of the fuel employed. Apart from its effect on the yield of methane, pressure also offered other important advantages, not least being the ability readily to remove carbon dioxide merely by scrubbing with water, easier purification of the gas from H_2S, and reduction of ground space occupied by the plant.

Subsequently, in 1936, a working size plant was erected in Zittau, using two generators capable of an output using lignite as a fuel, of 700,000 cu.ft. per day. The unit, operating at 20 atmospheres pressure, is illustrated in Fig. 1. Apart from the features of mechanical design necessary for pressure operation, it generally resembles the ordinary mechanical grate type of producer using dry box ash removal.

Fuel is fed into a chamber mounted on top of the main generator body. This can be connected either to the main chamber or to atmosphere by operating the conical shaped bell valves indicated. As the coal falls from the feed chamber into the main reaction vessel, an even distribution of fuel is effected by the conical shaped deflector plates, A, shown below the feed chamber.

The generator body consists in a double walled steel vessel; the function of the outer wall is solely to sustain the internal pressure and the inner of the two walls is a normal producer shell which, lined with refractory, contains the fuel bed. The space between the two walls constitutes a water cooling jacket, from which the steam evolved at generator pressure is led to the producer gas offtake, B. The diameter of the fuel bed thus contained is 8 ft. 3 in., the depth of bed

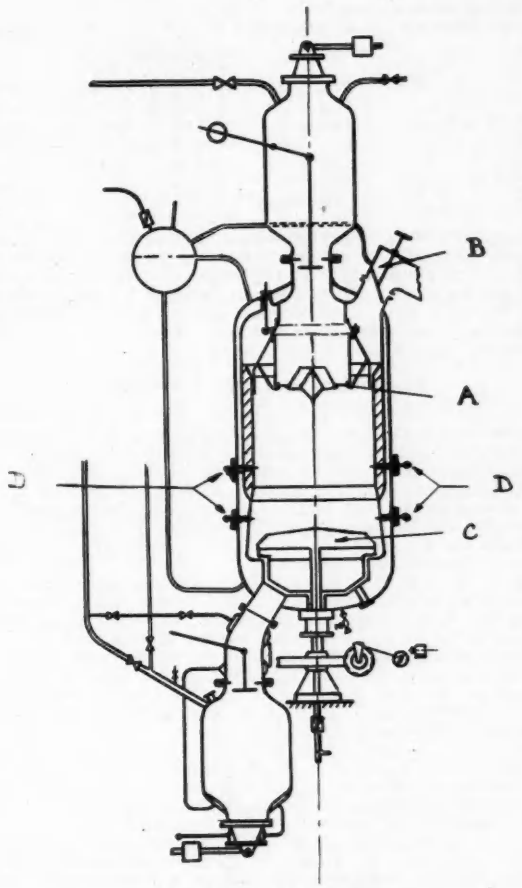


FIG. 1.—*Lurgi Producer*

is about 6 ft. with an ash layer below 1 ft. to 2 ft. in thickness. It is claimed that the unusual depth of fuel not only helps the synthesis of methane, by allowing adequate time of contact, but also serves as a protection against unconverted oxygen rising and burning the "make" or possibly causing an explosion.

The grate, C, slightly domed in profile, rotates continuously at a speed which can be varied as required, the steam and oxygen being introduced through a fixed central pipe co-axial with, and inside, the tubular shaft driving the grate.

The vertical vane below the main grate but attached to it serves to scoop the ash through the outlet into an ash container fixed to the underside of the main generator casing; and the operation of this container is similar to that of the feed chamber. Control of the grate speed and of the feed chamber is effected, in the absence of the sight holes and pokers normal to producer practice, by the indication of the hot zone position in the fuel bed as read on two sets of four thermocouples, D, fitted at two levels in the fuel bed. The temperature of the exit gas also aids in the control.

From a consideration of equilibrium in reaction (5), which indicates that a low temperature favours the formation of methane, the reason for operating the hot zone of the fuel bed at the unusually low temperature of 800° will be apparent. The steam for the blast is preheated to 500° C., probably the safe upper limit at the pressure concerned using the normal type of superheater, and this high superheat enables the oxygen blast content to be as low as 7% by volume. Fifty per cent. of the blast steam is gasified so that a typical analysis of the "make" at the producer exit is as follows:

	Wet basis (approx.)* %	Dry basis %
H_2O	27.8	—
CO_2	23.7	32.9
H_2S	0.9	1.3
C_nH_m	0.7	0.9
O_2	0.1	0.2
CO	9.5	13.2
H_2	25.3	35.0
CH_4	11.1	15.4
N_2	0.8	1.1

* No allowance for moisture resulting from coal drying.

After removal of water, CO_2, and H_2S, Lurgi gas from brown coal has the following typical composition (C.V. 445-480 B.Th.U./cu.ft.):

	Purified gas %
CO_2	6.3
H_2S	0.0
CnHm	0.8
O_2	0.1
CO	18.6
H_2	51.2
CH_4	22
N_2	1.0

Later, in 1940, a larger installation was erected at Böhlen, near Leipzig, comprising 10 generators, each 2.5 metres in diameter and producing an actual output of 150 million cu.metres per day which was supplied to the Leipzig-Magdeburg gas grid. A third plant was also erected at Brux, Czeckoslovakia, with an output of 80 million cu.metres per day. This plant was erected for the supply of synthesis gas to the nearby Fischer-Tropsch plant.

Researches at Leeds University

As already indicated the early Lurgi experiments had attracted the attention of the Joint Research Committee, and a fundamental investigation into the process was at once initiated at Leeds University; a major issue was the extent to which bituminous coals would supply a suitable reaction bed. For simplicity, early experiments were carried out with semi-cokes and were divided into two series, the one being concerned with the initial gasification reactions with semi-coke under pressure, and the other with the conversion of the gaseous products of these reactions into methane.

Much has still to be learned concerning the mechanism of the reactions of oxygen, steam, and carbon dioxide with carbonaceous materials. It is known that an adsorbed gaseous film or layer is formed on the surface of the solid, and the ultimate products are the outcome of reactions between the combining gases and such a film; the mechanism of solid catalysis is similar and both the efficiency of catalysts and the "reactivity" of solid fuels depends largely upon the "accommodation" factor of the material in question and the chemical reactivity of the film. In the oxidation process the nature of the film depends upon temperature, but at incandescence the initial gaseous product liberated is almost certainly carbon monoxide, and the rate of completion of its secondary combustion is, therefore, of importance. Studies so far reported indicate that reaction velocity in fuel beds is proportional to the oxygen pressure, but at high temperatures the aerodynamical nature of its passage over the surface is equally important. Dr. Orning, of the Carnegie Institute of Technology, Pittsburg, has studied the influence of oxygen pressure on the combustion of pulverized fuel particles in connexion with the use of solid fuels for gas turbines, and he reported at the recent Harrogate Conference on Pulverized Fuel that his preliminary data indicated that the temperature required to bring about ignition was not particularly dependent upon pressure. While pressure induced an increase in the rate of burning, this was not proportional to it.

It is well known that reaction with oxygen is much faster than reaction with steam so that the latter is likely to exert a controlling influence. As part of the Joint Research Committee's programme, Dr. A. Key examined the influence of pressure on the reactions of both steam and carbon dioxide on coke; his results indicated mechanism not unlike that outlined for the oxidation reaction; thus "the first step is the production from the carbon dioxide of one molecule of carbon monoxide in the gaseous phase and one atom of oxygen held on the surface of the carbon. The second step is the removal of this oxygen atom from the surface as a second molecule of carbon monoxide, thus gasifying an atom of carbon."* The steam reaction is similar.

The reactivity of the semi-coke was found to be of importance in both the initial and in the subsequent methane-forming reactions and a likely economy in oxygen consumption was indicated either by pre-heating the supply or by treating the semi-cokes with alkali. The high yields of methane secured by operating under pressure were also at once established and a matter of great interest was that the composition of the gaseous products indicated that equilibrium was rapidly established in all the well-known reversible systems participating. But by far the most striking observation was that methane formation did not depend upon its synthesis from carbon monoxide and hydrogen but upon direct hydrogenation of the coal substance, according to the reaction $C + 2H_2 \rightleftarrows CH_4$, a process obviously responding to pressure. At 900° C. the rate of hydrogenation was very rapid and it was possible completely to gasify the fuel; interesting also was the observation that aromatic hydrocarbons such as benzene, anthracene, and xylene were all as easily hydrogenated to methane at the temperatures in question. Subsequent experiments in wider reaction vessels gave rise to another finding of paramount importance—namely, that on the attainment of an adequate pressure, the hydrogenation reaction, being strongly exothermic, can be autogenously propagated through a *cold* fuel bed provided an adequate initiating temperature of the order of 500° C. has been applied locally. Following the autogenous passage of this reaction through the bed, a highly reactive residue was left, all sulphur was converted into H_2S, and an encouraging yield of liquid hydrogenated products resulted. During the last few years the work has proceeded beyond the laboratories at Leeds to the semi-technical scale, large reaction vessels being employed, and further information is accruing.

A number of possible applications of the results have presented themselves and their general assessment is being made by the Gas Research Board, to whose recent Annual Reports reference may be made. Particular consideration is being given to the possible advantages of pre-treatment of the fuel, and developing continuous, as distinct from intermittent, processes. Further, the *catalytic* synthesis of methane from water gas has been successfully achieved as an independent process, and it may well find some place in the ultimate possible schemes.

* 4th Annual Report of the Council of the Gas Research Board, 1942-43, p. 15.

The Winkler Process

The Winkler producer as illustrated in Fig. 2 was proposed in 1925 as a means of processing brown coal fines without the need for an intermediate briquetting stage necessary before they could be used in a normal gas generator. The body of the producer is a tall vertical steel cylinder 65 ft. high and 18 ft. in diameter; a flat grate forms the bottom and the blast is led through the slots provided. The fuel bed, 3 ft. to 5 ft. in depth, is not stationary but is kept in a constant state of agitation by the passage of this blast and its top surface has the appearance of a boiling liquid which gives this type of fuel bed the name, a "boiling bed." Actually a multitude of small gas channels allowing passage of the gas are formed, and it is clear that these channels must not be self perpetuating—*i.e.*, the fuel surrounding any given channel must always be able to collapse so that the channel may re-form elsewhere; for this reason a caking coal cannot be used in a boiling bed. The coal, though fine, must be closely sized in order to minimize the inevitable "carry-over," and this seems to vary between 20 to 50% of the total coal feed depending on the closeness of the sizing. The large volume afforded above the fuel bed by the tall cylindrical generator casing is designed to allow gasification of the carry-over fuel in suspension by means of a secondary oxygen blast.

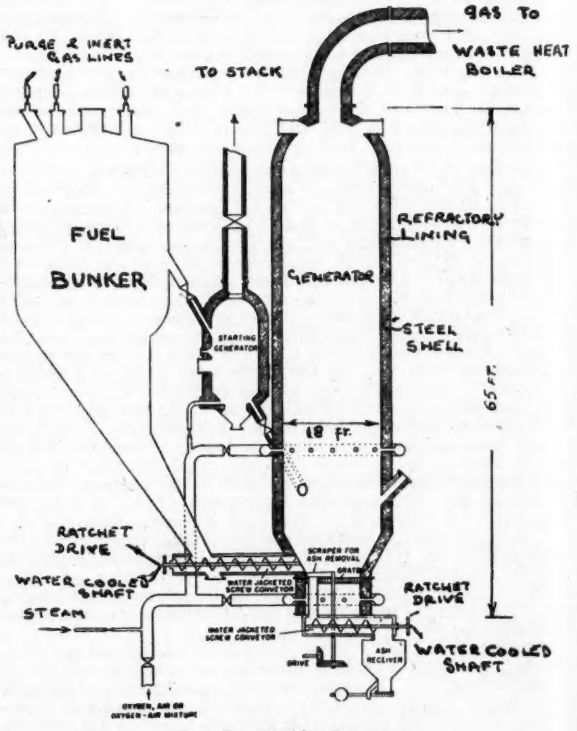


FIG. 2.—*Winkler Generator*

The rating—*i.e.*, fuel converted per sq. ft. of grate area—is from 1½ to 3 times that of a normal "blow" and "run" gas generator; *i.e.*, about 40 tons/hour normal rating on a grate about 18 ft. in diameter giving 180,000 cu.ft. per hour of water gas. The percentage of oxygen in the oxygen-steam blast is usually about 20 but it could be as much as 50 as the throughput of the generator is not limited by necessity to avoid fusion of the ash. The ash tends to segregate by reason of the agitation of the bed and is removed by a conveyor screw diametrically opposite to the feed screw. About 20 Winkler plants have been reported in industrial operation for synthesis gas production, Leuna, Zeitz, Bohlen, and Magdeburg having three large units each and Brux, in Czechoslovakia, having six.

I.C.I. Fluidized Gas Generator

While dealing with producers employing non-stationary fuel beds, it is of interest to mention a novel design recently patented by I.C.I., Ltd., the diagrammatic plan being shown in Fig. 3. A fine fuel is employed in such a way that it can flow as a fluid when required, the conversion process taking place with the coal in suspension rather than in the form of a boiling bed.*

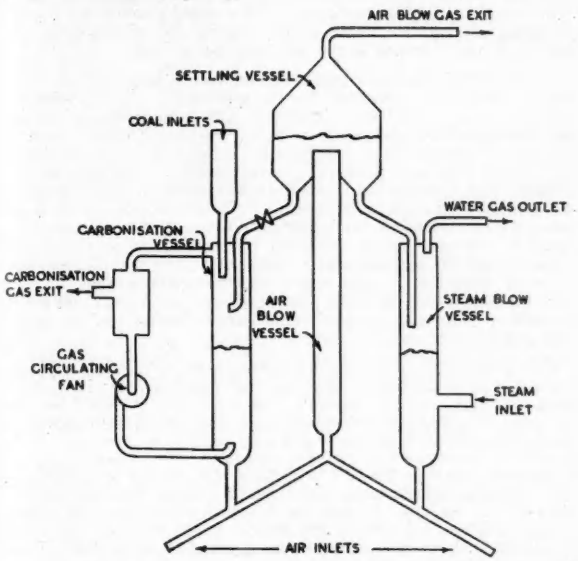


FIG. 3.—*Imperial Chemical Industries Fluidized Water Gas Generator*

Powdered coal is fed from an inlet vessel into a coal carbonization vessel where the burden of coal is kept in a state of agitation by the passage upwards through it of hot town gas which is circulated through the vessel by means of a fan; a gasholder is also included in the circuit. The temperature requisite for carbonization, about 800° C., is maintained by allowing sufficient air into the carbonization vessel with the gas supply. The carbonized coal is then injected by means of an air inlet jet into the bottom of the air blow vessel through which coked coal and air pass upwards, reacting to CO and raising the coke particles to incandescence. The top of this vessel is enlarged (settling vessel) so as to retain the hot coke while the air blow gas is led away at the top; the coke can then be fed by gravity to the steam blow vessel shown on the right of Fig. 3. The steam is admitted by a side pipe one-third of the way from the bottom of this vessel and the water gas is generated by the counter-current reaction between steam and hot coke, the water gas being finally led away at the top.

On reaching the bottom of the steam blow vessel, the coke, now cooled by the endothermic reaction with steam, can be re-injected into the air blow vessel by an air inlet jet together with the carbonized feed. The coke can be purged sufficiently to reduce the ash content through a purge line (not shown). A high ash content does not hinder and may assist the action owing to its function as a heat carrier from the air blow to the steam blow vessel.

Koppers Gasification Process

Among the German designs in the non-stationary fuel class, the Koppers powdered fuel gasification process presents certain novel features of interest. This plant, which seems successfully to have passed pilot plant trials, is show in broad outline in Fig. 4. The essential part of the plant, the primary reaction chamber, appears to have been inspired by plate column design, with a view to obtaining good mass transfer in the conversion process. Few details of the plant are available, but it seems that an oxygen-steam blast, after preheating, is led into the bottom of the primary reaction chamber; powdered coal enters one section about one-third of the way from the bottom of the shaft. This shaft generator is divided into several sections in each of which local turbulence is promoted by arranging a restricted opening for the main rising stream of gas as it enters the section and also by having an additional side port through which either steam, oxygen or fuel may be fed as conditions determine.

The hot coke filter shown serves both to trap the fuel carried from the two shaft-like chambers and as a safety device for consuming unburnt oxygen in the event of failure of the pulverized fuel supply.

* Fluidized systems have recently been discussed by Dr. J. G. King, Director of the Gas Research Board, in a Paper, "The Control of Chemical Reactions on a Large Scale," recently presented (1947) to the Institution of Gas Engineers.

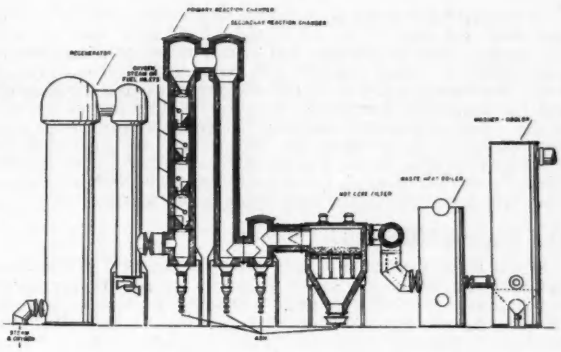


FIG. 4.—*Koppers P.F. Synthesis Gas Plant*

Thyssen-Galocsy and Other Slagging Producers

The method of ash removal in a producer has always had a dominating influence on its design and with oxygen blasts, it was natural that slagging producers where the ash was handled in the molten state should be investigated. While there were a few slagging producers of simple construction in operation at Leuna which gave a gas high in CO and low in H_2, the Thyssen-Galocsy producer (see Fig. 5) is of the greater technical interest.

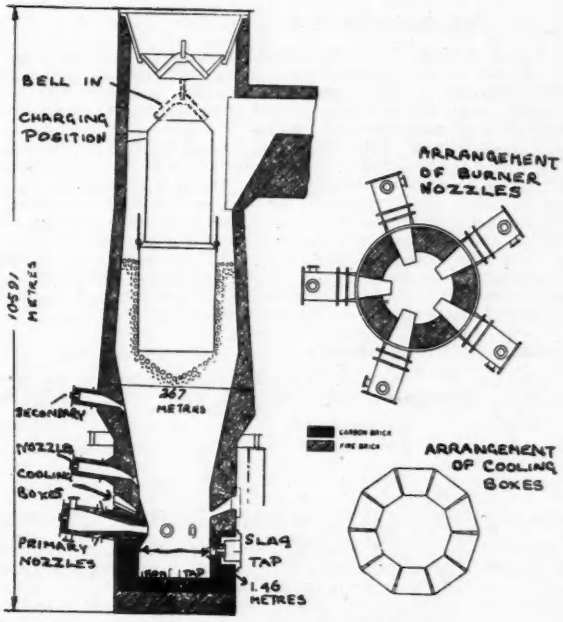


FIG. 5.—*Thyssen-Galocsy Slagging Generator*

The producer, like all other "slaggers," resembles a blast furnace in appearance, and differs from normal in that three rows of tuyers are provided. Through the bottom row a mixture of oxygen and recycled water gas is blown in order to give very highly superheated steam as a product of combustion. This rises to combine with the main blast, which is led through either of the two upper rows so that the water gas reaction may proceed at a peak temperature of approximately 1,600° C. The main blast consists essentially of oxygen with enough additional steam to bring the final composition of the product to the desired hydrogen and carbon monoxide content.

Galocsy claimed for this method of operation a good performance on steam decomposition without resorting to such excessive temperatures that the refractory walls of the producer were adversely affected. Nonetheless, it can hardly be claimed that to produce steam by recycling gas and burning it is, on the face of it, profitable; and the process seems to have been adversely criticized, especially by the Leuna engineers, who appeared to have obtained much the same type of gas on their simpler producer with the same or even better oxygen efficiency. The latter value is the main criterion of the performance of the slagging producer on account of (*a*) the high percentage (circa. 60%) of oxygen necessary in the resultant blast, and (*b*) the inevitably greater heat losses.

In contrast with the use of an oxygen-steam blast, water gas quality can, of course, also be obtained by the use of steam alone, provided the reaction zone of the fuel bed is maintained at a temperature above 700° C. Much ingenuity has been devoted to development work in Germany in order to manufacture water gas continuously; and the conditions described are not readily attainable by ordinary design. Various proposals described in German journals in the inter-war years make interesting reading, and seem to have applications to activities other than in the Gas Industry; attention will be confined briefly to two plants which reached full competitive industrial status. Both were inspired originally by the standard vertical retort.

The Pintsch-Hillebrand Process

In this plant, the first of which was erected in 1932 at Hamburg, the carbonization and gasification stages are more or less continuous in a large vertical retort into the bottom of which the blast consisting of reaction steam plus a portion of the gas make is led. This blast is previously preheated in separately fired regenerators to a temperature of 1,300° C.; thus the heat of the steam is augmented for reaction purposes by that of the recycle gas which, of course, is chemically inert. Mixture proportion and thermal conditions are arranged so that good conversion is obtained; and brown coal briquettes are the standard material employed. A fuel with low ash fusion point cannot be used as this would adversely affect permissible steam temperature and hence reaction rate. The plants seem to have worked without major trouble; one point of significance to these islands is that one plant is reported to have run successfully on peat briquettes. Some rough cost figures which have been made on the basis of published German data indicate that the plant may be competitive if it is ever proposed to obtain water gas from peat; carburetting would, of course, raise calorific value.

The Bubiag-Didier Process

This plant whose development was contemporary with the Pintsch-Hillebrand does not attempt the extreme blast temperatures of the latter process. It does, however, endeavour to obtain high heat transfer across the wall of a vertical retort and some attention has been paid to utilizing waste heat; thus the steam for reaction is obtained by using the hot gases leaving the coal supply end of the retort after drying the brown coal. Not all the coke is gasified in the retort, as enough is extracted to feed a separate gas producer, the supply from which is used first to heat the retort and afterwards to preheat the steam for the retort reaction. These gases leave the retort at 700° C. and the retort temperature must be well above this figure.

The design appears to have found favour in Germany, as several large plants were erected; but the largest installation of retorts, reported under construction in Manchuria in 1941, had a designed output of 43,000,000 cu.ft. per day of synthesis gas.

General Considerations

Questions of "integrating" Great Britain's fuel energy resources so that a minimum of wastage occurs are much to the fore in these times and a consideration of the case for gasification indicates that there is every reason for expansion in this field. The National Coal Surveys predict the virtual exhaustion of our coking coal supplies in 50 to 100 years and this of itself raises the desirability of the extended use of gas in place of coke as a convenient domestic and industrial fuel. In view of the fact that certain industrial plants—*e.g.*, blast furnaces and zinc smelting retorts—are obliged by their very nature to use coke, the utilization of non-coking coals, for example, the Scottish "flame" and free burning types, comes considerably nearer than a problem for 50 years hence. This country should see a period of plant development, fitted to our special fuel situation and not unlike that of Germany in the early nineteen-twenties.

A word regarding underground gasification may not be out of place. The fairly extensive Russian experiments do not appear to compare well on the basis of efficiency with normal mining methods. Much of the total coal seems to be left in the pit; but we have still to evaluate the method as a means of "cleaning up" exhausted mines or dealing with unworkable and narrow seams. In such event, the pithead then becomes the gasification centre and may enable the economical large scale use of oxygen. Whatever be the case for underground gasification, other considerations—*e.g.*, transport costs, &c.—seem to present a strong argument for gasification at the pithead, using normal mining methods. Further, the increase of small coals resulting from the extended use of mechanical devices in the mines and the poor coking qualities of many easily mined coals will tend to provide a promising future for gasification methods of the boiling bed and fluidized reaction types.

On the other side of the picture researches on techniques for producing cokes from anthracite and other non-coking coals have shown some promise in the laboratory, and there may possibly be scope for them provided that practical industrial methods for effecting the somewhat difficult heat treatments can be evolved.

There is much in this Lecture which may already be familiar. I trust, however, I have related a story revealing, in fitting commemoration of him we now honour, the interlock of science and practice in a field, interesting in itself, and likely to become of great importance if all our coal reserves are to be turned to best advantage. I have also endeavoured to direct attention to the service rendered to the Gas Industry by successive generations of research workers within the precincts of Leeds University. Year in, year out, they have laboured unselfishly, many having foregone the personal advancement and distinction which would undoubtedly have been theirs had they sought the direct path of industry; and having been privileged to be associated there with those who have worked so devotedly in researches considered in this Lecture, I conclude with my personal tribute to them.

My manuscript has been composed under conditions of pressure and I therefore crave indulgence for imperfections of which I am myself conscious; its preparation would not have been possible but for the unstinted assistance of my colleague, Dr. G. W. C. Allan, in the British Coal Utilization Research Association.

LOG SHEETS FOR STEAM BOILER PLANTS

The high cost of fuel which is likely to be a permanent feature of our industrial economy, coupled with shortage of supplies, a condition which may last for some years, makes efficiency in the use of fuel imperative. Efficient generation of steam used for power or process work is also likely to improve production on the works, with consequent increased output and reduction in manufacturing costs. Any measures that can be taken to that end will be to the financial advantage of the user and in the national interest.

It is exceedingly difficult, if not impossible, to maintain efficiency unless performance records are kept. By recording faithfully conditions at the boiler house, disturbances can be detected early and rectified before they lead to waste and other serious consequences such as shortage of steam or positive breakdown. Many users of smaller steam generating plants—and of some larger ones, too—keep no records and do not know whether their works are reasonably efficient or not.

The charts now published by the British Standards Institution in B.S. 1345, Log Sheets for Steam Boiler Plants, have been prepared by practical boiler engineers from industry and Government Departments to help those who have not hitherto kept adequate records. They are regarded as the minimum observations that should be made. Used systematically and regularly, and if submitted to careful examination each day by the engineer-in-charge or other responsible person, they should go far towards ensuring a regular increase in the quantity of steam produced from each pound of coal put into the boiler furnace.

Copies of this specification may be obtained from the British Standards Institution, Sales Department, 24, Victoria Street, London, S.W.1, price 2s., post free. Supplies of log sheets themselves and summary sheets for regular use can be obtained from the same address. The daily log sheets are available in two sizes, the smaller suitable for intermittent working only and the larger for 24 hour working on the basis of hourly readings.

SCOTTISH OFFICE OF D.S.I.R.

The Department of Scientific and Industrial Research has opened a Scottish Office at 18, Melville Street, Edinburgh, to facilitate closer contact with Scotland. The office will have a dual function—to encourage the prosecution of research by industry itself and to increase the effectiveness of the contribution which existing Government research establishments make to Scottish industry.

The new office will co-operate with the Departments of the Secretary of State for Scotland, with the organizations in Scotland of other Government Departments, and with voluntary bodies such as the Scottish Council (Development and Industry). It will also study the Scottish industrial position with a view to assisting in the formulation of problems suitable for research. The office will apply existing research facilities as effectively as possible to Scottish needs. It will also provide means of encouraging contacts between Scottish firms, the D.S.I.R. Laboratories, and the Research Associations, and will help to make more readily available in Scotland a large volume of scientific information already existing within the D.S.I.R. organization.

Dr. H. Buckley will be in charge of the office. A graduate of Manchester University, he was on the staff of Toronto University before serving for 25 years on the staff of the National Physical Laboratory, where his special field of research was concerned with photometry and illumination. During World War II he was for a time a Liaison Officer in the British Commonwealth Scientific Office in Washington, and during the last three years was a member of the Intelligence Division at the Department's Headquarters.

GAS CONVERSIONS IN THE BAKEHOUSE*

With Special Reference to the Automatic Control

By JOHN H. FULTON,

Engineer and Manager, Haddington Gas Company, Ltd.

Historical

THE early Roman oven consisted essentially of a baking chamber with a domed top, which was heated by wood or charcoal. When the oven was considered sufficiently hot the ashes were raked into the ashpit and the bread placed in the oven. This oven had a large space on top of the actual baking chamber, which space also extended around the sides of the oven, so that in one of the earliest of all ovens we find almost the same principle as the heat trap which was perfected almost 2,000 years later.

Ovens throughout the ages have closely followed along the lines of the Roman oven, but the principle of the heat trap appears to have been discarded and the side flue oven and the Scotch oven came into being. These ovens were usually square in plan and fitted with a beehive crown of stone or brick and a thick stone sole. The fire of wood or, later, coal, was placed in one corner, near the door, the flue outlet being placed in the corner near to, but on the opposite side of, the door to the fire. The shape of the crown effected the heat circulation, and the oven was fired to heat up previous to baking. Here also, the fire had to be raked out and the oven "scuffled" by means of a wet sack fastened to a long pole before the bread was set.

In 1635, Henry Sibthorpe, described as a "Well beloved and loyal subject of Their Majesties" and his profession given as that of a Sergeant Major, was granted a patent for which was claimed:

"The arte and skill of erecting and making Ovens in such sort as the said Bakers bakeing cookes and other persons, may heat the same oven with sea coales or any other coales digged out of the earth, and therewith may bake as soone and as fayre and for lease charge than they nowe doe in heating with wood and with much more safety."

No detailed specification or drawing was enrolled, but it is supposed that Sergeant Major Sibthorpe may have introduced a grate bottom and ashpit into the original wood ovens. The Roman oven, it should be noted, already had that.

In 1810 a patent was granted for a travelling oven, the goods being placed on an endless band of wire cloth passing over suitably placed rollers. As Boulton and Watt only began to develop the steam engine for driving power looms in the early 19th century, it is reasonable to assume that this first travelling oven was operated by hand. About 1850, patents were taken out by Robinson and Lee, and by Perkins, for ovens heated by steam pipes placed outside the oven chambers —the first step towards the modern steam tube oven.

Use of Gas as Fuel

Ovens, which were originally fired with wood or charcoal, gradually went on to other fuels such as "sea coale," due no doubt to Sibthorpe's patent, until the popularity of the steam tube oven brought coke into almost universal use as the fuel. Although gas firing is usually regarded as a recent refinement, it should be noted that the "Introduction to Abridgements of Specifications, A.D. 1634-1866, Class 71," published in 1873, states:

"Gas, which is now extensively used, seems to offer sufficient advantage as regards cleanliness and readiness of application, to induce a considerable use of it in place of coal."

Lloyd ("Theory of Industrial Gas Heating") says: "The best figures so far obtained for bread baking with gas may be taken to be 1.5 therms per sack of flour." He estimates the thermal efficiency of an oven operating at this rate to be 53.4%. These figures are, however, obtainable only with travelling ovens specially designed for gas firing and with a good load factor. For draw plate steam tube ovens converted from solid fuel firing, the consumption appears to vary between 2.75 (good load factor) and 4.5 (poor load factor) therms per sack of flour. The efficiencies corresponding to these figures are 29.1% and 17.8% respectively. The thermal efficiency of the latter type of oven when fired with coke (for bread baking only) is estimated to be 12.5%.

* Paper to the North British Association of Gas Managers, St. Andrews, Sept. 11.

Comparative Costs following a Conversion

The following details relate to a conversion of five single-deck, steam tube, draw plate ovens carried out a short time ago at Dumbarton.

Each oven has one draw plate 12 ft. by 8 ft. 6 in. and is capable of baking about nine 280 lb. sacks of flour per night shift of 12 hours. The oven heating system is on the indirect principle, with the furnace box at the rear of the oven. There are 20 tubes above, and 25 below the draw plate, each tube being a closed circuit approximately one-third full of water. One end of each tube is opened out to form a loop, the loops projecting into the firebox.

The flow of the heating gases from the burning fuel is controlled by a main damper and two auxiliary dampers. The main damper is situated in the main flue leading to the chimney and controls the pull at the base of the firebox. The auxiliary dampers control the flow of hot combustion products over the two sets of loops. A portion of the hot gases is drawn over the outer ends of the lower loops, through between the loops, and down into a flue on the left side of the firebox. This flue passes to the front of the firebox (*i.e.*, the rear of the oven) and then upwards past one auxiliary damper to the main flue.

The remainder of the hot gases is drawn up and through the upper set of loops, and into the flue on the right-hand side. This flue also travels to the front of the firebox, and upwards past the second auxiliary damper to the main flue.

The water inside the tubes is converted to superheated steam and circulates round each tube, thus carrying the heat from the furnace to the oven. For bread-baking, a temperature of 420° F. is required in the oven, the temperature falling quickly to about 380° F. when the batch is set in the oven and returning to the original temperature slowly. The temperature is raised quickly over the last 15 to 20 minutes of baking to put a crust on the loaf. This increase is obtained, when firing with coke, by opening the dampers to increase the rate of combustion of the fuel. Control is not easy, much depending on the state of the fuel bed at the time, and the skill of the operator.

The conversion of each oven took five days. The furnace bars, front wall of the furnace, and side linings were first removed. A hollow wall was built up on each side, the breadth of the furnace box being reduced to a size just sufficient to accommodate the loops of the steam tubes. The hollow walls were filled with glass wool for insulation. To prevent direct impingement of the gas flames on to the lower loops (which might cause failure of a tube due to overheating) a protection of fire brick, 2 in. thick, was built along the sloping undersides of the lower loops. This fire brick baffle also served to direct the hot products up to the outer sides of the loops.

A five jet semi-luminous type Selas burner was built into the front wall of the firebox, its capacity being about 750 cu.ft. per hour at 3 in. pressure. Admission of air for combustion was controlled by a hinged plate, which could be fixed in the required position on a slotted quadrant by a wing nut. A lighting port was provided just above the hinged air control plate, and a lighting poker attached by a suitable length of flexible tubing to a cock fitted prior to the main gas control cock.

Details of a test on the first oven converted are given in Appendix I, bread only being baked in the oven. It will be noted that the consumption of gas was 3.03 therms per sack, corresponding to a thermal efficiency of 26.4%. The cost of gas per sack with gas at 7.26d. per therm was 1s. 10d., compared with 1s. 11.52d. per sack for coke firing (including labour for firing and handling coke and ashes).

Appendix II records a comparison of the baking costs before and after the conversion of the five ovens. All five ovens now had thermostatic control of oven temperature, the thermostat being placed close to the oven thermometer in the framework of the oven charging door, just above the door. All the work formerly carried out in the five draw-plate ovens and in three Scotch ovens was now done in the draw-plate ovens only, without any considerable increase in the time worked in the bakehouse. This was achieved by the quicker heating up of the ovens, steadier temperature control, and use of residual heat for baking "smalls." The amount of bread being baked was roughly 60% of the total sackage being passed through the ovens.

It is seen that, when only the cost of fuel used is considered there

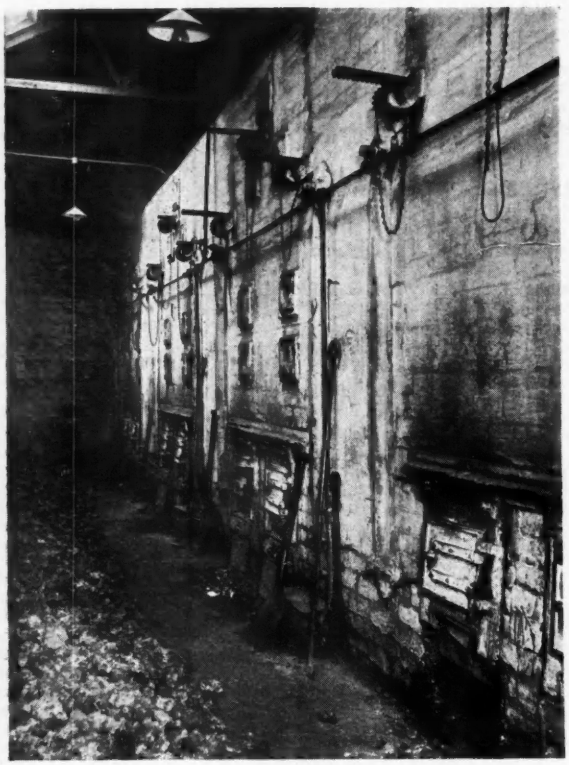


Fig. 1. Rear of draw-plate before conversion.
(Oldham Industrial Co-op. Soc.)

was an increase in the cost per sack when gas firing was introduced. When, however, the labour charges incurred when firing with coke are taken into account, a saving of 0.78d. per sack in favour of gas was obtained. This reduction was achieved despite an increase in the consumption of gas from 3.03 therms per sack for bread-baking only to 4.65 therms per sack when bread amounted to about 60% of the total sackage baked. The thermal efficiency of the baking process fell from 26.4% to 17.2%, but this is still above the thermal efficiency with coke firing (12.5%).

Automatic Control

In the conversion outlined above, only the simplest of controls was installed. At first, the rate of gas consumption was controlled by hand. Later, thermostatic control was installed. The thermostat was of the rod type operating a control valve situated in the main gas supply. There was no automatic control of the air supply so that, with the air shutter set for a high gas rate, there was an excess of air admitted for combustion when the gas rate was cut down by the thermostat.

An improved control system—the "Visomatic" system—has recently been marketed by Mr. F. Burton. The following advantages are claimed for this system:

(1) *Reliability*. Every precaution is taken to safeguard the oven against overheating, and against gas failure or the extinction of the pilot flame. Should the electrical supply fail and thus immobilise the automatic controls, the equipment can be operated by hand.

(2) *Remote Indication*. In the case of ovens where firing is at a distance from the oven mouth (*e.g.*, the draw-plate ovens mentioned previously) the baker may require to walk round to the rear of the oven to examine the controls. With the Visomatic system, a panel situated at the front of the oven indicates the setting of the controls, and also shows the amount of gas actually passing to the burner.

(3) *Adaptability*. The Visomatic control system can be adapted for any type of baker's oven.

(4) *Periodical Inspection* is carried out without interfering with the working of the oven at low cost, providing assurance of uninterrupted service from the equipment.

General Specification

The Burner Set consists of:

(*a*) A double flanged cast iron frame for forming a clear opening in the outside wall of the furnace. One flange is machined to take the mild steel burner assembly plate on which are mounted the component parts of the burner.

(*b*) The burner, which is built of a series of jets firing through circular blocks. The number and spacing of the jets are determined by the width of the furnace, the gas rating for the size of oven, and the positioning of the heating elements in the case of steam tube ovens. Each jet is fitted with a union for easy removal through the air aperture without dismantling the burner. The burner is of the non-aerated type.

(*c*) A mica observation window is provided in the burner assembly plate.

(*d*) An automatic combustion air regulator, which is a machined metal cylindrical shutter mounted on ball bearings and accommodated in a brass housing. The full opening of the shutter is 75° rotation, but in order that correct air adjustment can be made, an adjustable stop is fitted to the spindle at one end together with a graduated scale on the rotor casing. The stop is locked to the spindle in the desired position by a screw. The shutter is operated by a valve situated at the end of the main supply line to the burner. Increase in the supply of gas to the burner lifts the valve, causing the cylinder to rotate and allow more air to pass into the combustion chamber. When the gas rate is reduced due to the operation of the thermostat, the control valve falls, and less air passes to the combustion chamber. This prevents excess of air entering the flues during periods of low gas rate, and producing a cooling effect which would result in a demand for more gas.

(*e*) A combined flow and pressure gauge which indicates the gas rate under all conditions of operation is mounted on the burner assembly plate.

Thermostats

Regulating Thermostat. This is a dial thermostat having a robust mercury-in-steel movement, specially designed for the control of electrically operated valves by means of a tilting mercury switch housed in the cast iron case of the instrument. The scale is 5 in. long, and graduated 200°-600° F. The setting pointer (coloured red) is adjustable over the whole range by means of a removable key, the actual temperature being indicated by a black pointer. The bulb and rigid stem are secured in position in the oven by means of an adjustable flange, and connected to the housing by copper-clad steel capillary tubing.

Excess Temperature Cut-off. A rod thermostat with patented snap action switch may be fitted as an additional safeguard in case of a failure of the regulating thermostat. This is normally set to switch off the current to the magnetic valve if the temperature exceeds a pre-set limit due to the regulating thermostat failing to operate. This cut-off is recommended for all steam tube ovens.

Magnetic Gas Control Valve. This is an electrically operated fullway valve, the valve plunger being of the impact type. Thus, when the coil is energized, the plunger gains momentum before lifting the valve, ensuring efficient and rapid opening. The operating coil is completely sealed against moisture.

Bypass. An external bypass is provided which is capable of passing practically full flow when the cock is in the "open" position. When the cock is in the normal (closed) position, a small drilling passes sufficient gas to maintain a low flame at the burner—*i.e.*, the bypass cannot be completely closed. Thus when the magnetic control valve closes at the dictation of the regulating thermostat, the burner flame is turned down, not out. The bypass tap is fitted with a detector switch electrically connected to the Visomatic controller.

Manual Control Tap. A control tap of improved type is provided, fitted with a detector switch connected to the Visomatic controller.

Gas Governor and Cut-off. This operates:

(*a*) To govern the gas pressure as required—2 in.-3 in. W.G.; (*b*) in the event of a failure of the gas supply, to close a valve in the gas supply pipe, thus preventing unburnt gas passing into the combustion chamber when the supply is re-established. The gas supply is only restored after the burner control cock and pilot flame control cock are closed.

Pilot Flame Protection. A thermo-electric pilot flame thermostat is fitted to ensure that if the pilot flame is extinguished for any reason, the supply to the main burner is cut off.

The Visomatic Controller. This is mounted in a convenient position near the regulating thermostat on the oven front, and provides the operator with a continuous record of the setting and operation of the various automatic and manual controls. The patented flow gauge incorporated in the controller shows at a glance how much gas is passing to the burner, and is a constant check on the working of the thermostat. Provision is made for the inclusion of an electrically operated time switch in the controller, which would enable the operator to pre-select the time at which heating up of the oven is to commence.

Results with the Visomatic Control System

The following weekly figures have been obtained for a mixed trade of bread and confectionery in steam tube draw-plate ovens:

Total therms used	850
Total flour baked in sacks	226
Therms per sack of flour	3.76
Selling value for bread	£720 approx.
Selling value for confectionery	£500 approx.
Estimated thermal efficiency	21%

The gas consumption of 3.76 therms per sack is lower than that obtained in the Dumbarton tests, where thermostatic control was

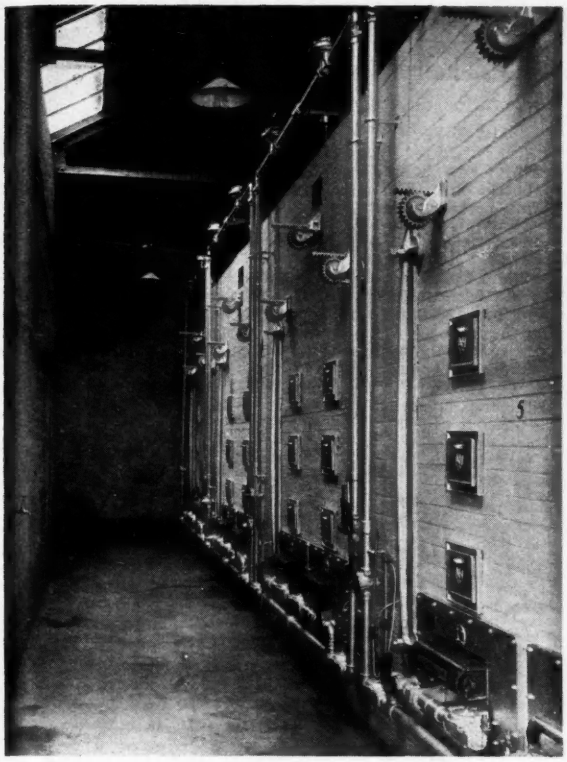


Fig. 2. Same view, after conversion, showing Burner Sets

fitted, but no air control, and is very good for a mixed trade baked in steam tube draw-plate ovens. With ovens wholly engaged on smalls or confectionery, the gas consumption may be as high as 8-10 therms per sack.

Advantages of Gas-Firing

(1) Elimination of labour costs for stoking and transport of coke (or coal) and ashes, and release of this labour for other more productive work in the bakehouse.

(2) As no solid fuel and ashes are handled in the bakery, cleaner and more hygienic conditions should result.

(3) Owing to the use of a clean fuel, the life of the brickwork in the firebox and flues should be increased—the estimated life of this brickwork with gas-firing is six years, compared with one year for coke-firing. Also, no dust is deposited in the nests of steam tubes. An annual saving of about £40 per oven may result from the increased life of the brickwork and the fact that no flue cleaning is required.

(4) The introduction of automatic control considerably reduces the supervision required for the maintenance of the desired temperatures within the oven and leads to greater economies in the consumption of gas.

Conclusion

There is apparent in the bakery trade at the present time a desire to improve conditions in the bakehouse. It is now felt that the expert baker should no longer be expected also to act as a stoker and ash remover. The larger bakeries are looking now for a fuel which will eliminate these duties without any increase in the cost of production. In smaller bakehouses, where the owner is himself the baker, it may not be possible to make out such a good case financially for conversion to gas, for the labour cost is less easily applied. Here, however, when it becomes necessary to have a thorough and expensive overhaul of the oven, it may be possible to persuade the baker to instal instead a gas-fired oven, with all its attendant advantages.

A. E. Livett in his Paper "Bread Baking"* estimated the average consumption of bread per person per annum at some 208 lb., and the gas required to bake this amount of bread in efficient ovens as approximately 1.25 therms. This may amount to about 3% of gas sales. There is a further potential load in the bakehouse for steam-raising water-heating, baking plates, &c., which could bring the potential load up to fully 5% of all gas sales—a load which would improve the load factor of the gas undertaking and help to lower the cost per therm produced and distributed.

I wish to express my thanks to Mr. F. Burton for permission to include the historical notes and the specification of the Visomatic control system, and for providing the demonstration set; also to Mr. A. McFayden for permission to include some Dumbarton results.

* *Gas Times* Supplement, Jan. 9, 1946.

Appendix I

Comparison of Costs with Gas and Coke
(Bread-baking only)

Gas-firing:	
(1) Consumption of gas per sack of flour ..	3.03 therms
(2) Price of gas per therm	7.26d.
(3) Cost of gas per sack of flour	1s. 10d.
(4) Estimated thermal efficiency	26.4%
Coke-firing:	
(1) Consumption of coke per sack of flour ..	56 lb.
(2) Price per ton of coke at gas-works	52s. 3d.
(3) Cost of coke per sack of flour	1s. 3.68d.
Add Cost of attention to coke fires ..	5.35d. per sack
Transport charges on coke and ashes	2.49d. per sack
Total cost with coke-firing	1s. 11.52d. per sack
(4) Estimated thermal efficiency	12.5%

Appendix II

Comparative Statement of Fuel Costs in Bakery

	335th quarter (100% coke-firing)		336th quarter (100% coke-firing)		337th quarter (60% gas-firing)		338th quarter (100% gas-firing)	
	£ s. d.	Per sack (pence)	£ s. d.	Per sack (pence)	£ s. d.	Per sack (pence)	£ s. d.	Per sack (pence)
Coal	—	—	—	—	1 2 6	0.14	—	—
Electricity	52 18 4	6.73	70 19 6	9.06	59 1 1	7.44	41 16 6	5.12
Gas	3 15 5	0.48	4 15 2	0.61	158 16 3	20.01	279 16 0	34.22
Coke	197 3 8	25.07	210 6 0	26.86	121 13 1	15.33	42 9 1	5.19
Extra transport charges on coke and ashes ...	32 10 0	4.13	32 10 0	4.15	13 0 0	1.64	—	—
Extra wages at fires	70 1 2	8.90	70 1 2	8.95	28 0 0	3.53	—	—
	356 8 7	45.31	388 11 10	49.63	381 12 11	48.09	364 1 7	44.53
Number of sacks baked	1,888		1,879		1,904.5		1,962.5	
Price per sack	3s. 9.31d.		4s. 1.63d.		4s. 0.09d.		3s. 8.53d.	

NOTE. 1.—The charge for coke includes coke used for steam-raising, and in the Scotch ovens.
NOTE. 2.—Some baking was carried out in the Scotch ovens during the 338th quarter.
NOTE. 3.—The extra charges for transport of coke and ashes, and for stoking, in connexion with the five draw-plate ovens were computed as follows :—

Transport charges on coke and ashes at 50s. weekly ... ... £32 10s. 0d.
One man's wage for attention to fires ... ... £70 1s. 2d.

40% of these charges were made for the 337th quarter.

REPAIRS TO A LARGE GASHOLDER*

By J. P. SCOTT, B.Sc., A.R.I.C., M.Inst.GasE.
Works Superintendent, Edinburgh Corporation Gas Department

THIS short Paper is descriptive of the repair and maintenance work carried out on a large gasholder at Granton after being in continuous operation for a period of 45 years. Some of the work, *e.g.*, the renewal of guide roller pins, bushes, and the adjustment of carriages, was such as would be expected after so long a period in use, but it was felt that a description of the methods followed in carrying out the major repairs might be of general interest.

The gasholder has a total capacity of 7 million cu.ft., and the contents of the crown being 425,000 cu.ft., the actual working capacity is just over 6½ million cu.ft. It is a four-lift holder with latticed columns and guide framing, and underground brick and puddle tank. The crown is untrussed and, when grounded, rests on a pitch pine timber framing.

The general dimensions of the gasholder and tank are:

	Diameter ft.		Depth ft. in.
First or inner lift	241	×	36 0
Second lift	244	×	36 3
Third lift	247	×	36 0
Fourth lift	250	×	36 0
Number of latticed steel columns			26
			ft. in.
Diameter of tank			252 6
			ft. in.
Depth of tank			37 0
Depth to top of rest blocks			36 0

Prior to the outbreak of war, the periodical examination of the holder and observation during working had revealed the following defects:

(*a*) Considerable leakage from the cups which are of the bent type.

(*b*) Uneven landing of the various lifts, the outer lift being 4½ in. high at one side.

(*c*) Gas leakage from seams and rivets in vicinity of cups and dips.

(*d*) Pins and bushes of guide rollers slack and requiring renewal or overhaul.

(*e*) Severe wasting of the ¾ in. bolts attaching the ornamental " crown and thistle " finials to the top of each standard.

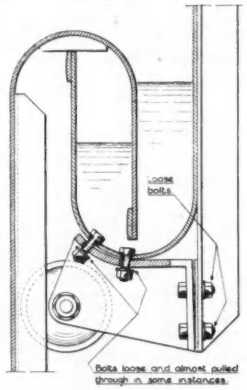


Fig. 1.
-Illustrating Cause of Cup Leakage.-

In accordance with the provisions of the Factories Act, 1937, every gasholder must be examined by a competent person at least once in every two years, and records of such examinations kept for inspection. In the case of a gasholder of which any lift has been in use for more than 20 years, the internal condition of the sheeting must, within two years of the coming into operation of the Act, and thereafter at least once in every ten years, be examined by a competent person by cutting samples from the crown and side sheeting or by other sufficient means and all samples so cut and a report on every such examination signed by the person making it shall be kept for inspection.

To comply with the Act, test discs were cut from the crown and side sheeting in 1938. The discs revealed that the sheeting was in remarkably good condition and varied little from the original thickness. They were bent to ⅛ in. internal radius without signs of fracture, thus showing an absence of brittleness or fatigue of the metal.

* Paper to the North British Association of Gas Managers, St. Andrews, Sept. 11.

The discs referred to are easily cut out with a hand-operated drill fitted with a trepanning tool which removes a disc of approximately 1 in. in diameter. The holes left in the sheeting are thereafter closed up with specially made bolts and cork washers.

The major items calling for repair were (*a*) the cup leakage and (*b*) the uneven landing of the lifts. The cup leakage had been evident for a number of years but had gradually grown worse despite attempts to arrest the leakage by means of cement, &c., and by attempted repairs from the outside of the holder. The chief difficulty was to locate the leakages which eventually were discovered to be coming mainly from the bolts securing the cup carriages and from loose rivets in the vertical sheeting adjacent to the cups. (See Fig. 1.) The leakage became so bad eventually that several pumps had to be kept in continuous operation to maintain the seal in the cups.

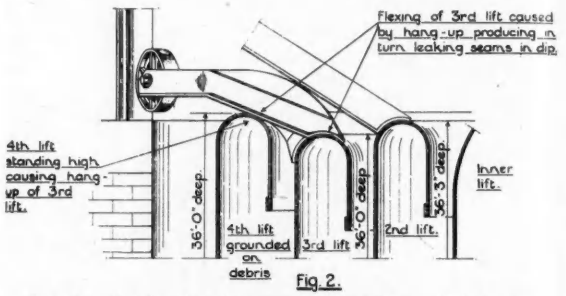

Flexing of 3rd lift caused by hang-up producing in turn leaking seams in dip.
4th lift standing high causing hang-up of 3rd lift.
36'-0" deep
4th lift grounded on debris
3rd lift
36'-0" deep
2nd lift.
36'-3" deep
Inner lift.

Fig. 2.
Damage to dip due to uneven landing of lifts on debris in bottom of tank.

The uneven landing of the lifts was apparently due to debris in the bottom of the tank accumulated over the years. The result was that, with the outer lift standing 4½ in. high, the third lift guide roller carriages rested on the dip of the outer lift and consequently these carriages were to a great extent actually supporting the weight of the third lift. (See Fig. 2.) A similar situation arose as the remaining two lifts were lowered. The result of this uneven loading was that considerable strain was put on each of the lifts and the resulting distortion caused rivets and seams to spring and thereby cause the leakage of water in the cups.

Various methods were considered for carrying out the major repairs and eventually it was decided that the cups should be repaired from rafts floating inside the holder and that the debris should be cleared by divers with the holder floating. These methods enabled the 6½ million gall. of water to be retained in the tank. The alternative method was to empty the tank, but it was considered that with all four lifts lying on the rest blocks at the bottom of the tank the proposed repairs would be more difficult and would take longer to carry out owing to the narrow spaces available for working at the cups and dips, &c.

Before the work could be put in hand, the war broke out and with the only other holder on the works withdrawn from use, the repairs had to be postponed. The condition of the telescopic holder deteriorated further but the gasholder position was eased when the second holder was again brought into use shortly before the end of the war. In the interval, the output of gas had increased so much that it was considered that all the work could not be carried out during the months of least demand, and a programme covering two years was drawn up. During the first year a thorough internal inspection was to be made and the leaking cups repaired, and the second year was to be devoted to clearing the tank bottom of debris.

With such a large volume of gas to be cleared from the crown, it was decided that the only method for removing it safely would be by purging with inert gas. This was done by the use of a Harrison purging machine.

Internal Examination and Repairs (First Year)

On completion of the purging operation and the removal of the purge gases by air, the manhole covers on the crown were removed. The water surface was found to be covered with an oil film which was removed as thoroughly as possible, and in addition the top 12 in. of foul water was removed and replaced by fresh water.

In order to give as much daylight as possible during the repair work, seven openings were cut at selected positions in the crown and tem-

porary frames with wired glass windows, each 15 in. square, were fitted. A new manhole was also made in the crown as near as possible to the outlet pipe within the tank, and the rafts in sections, and other inspection equipment passed through it. A rope ladder was lowered down the 48 in. outlet pipe and fixed to the to . Meanwhile, an air lock was fitted over the outer 48 in. stand pipe and a rope ladder lowered. Workmen thus were able to enter the holder by passing into the air lock, descending the rope ladder, crawling along the horizontal 48 in. main below the tank bottom and climbing up the inner 48 in. stand pipe. An air fan was connected to the tee at the top of the outlet main which had been disconnected and turned through an angle of 90°. With the manholes on the crown replaced, the holder was raised by the fan which had a capacity of 10,500 cu.ft. per minute against a pressure of 4 in. W.G. down to 5,500 cu.ft. per minute against a pressure of 8½ in. W.G. As the holder rose, a floating platform was erected round the top of the inner stand pipe on which was fixed a tripod with rope tackle for handling tools and material to be taken in and out of the holder from time to time. (See Fig. 3.)

A flameproof telephone of the mining type was fixed on this platform and connected to a telephone outside the holder. During the operations a man was stationed at each instrument so that the workmen were kept under continuous observation and contact maintained with responsible persons outside.

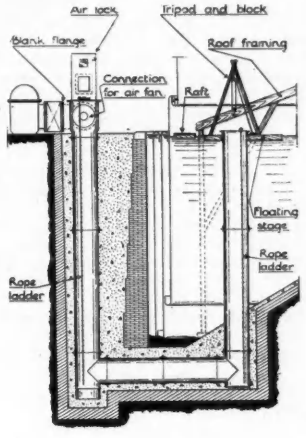


Fig. 3.
– Arrangements for access within Gasholder under air pressure. –

The repair equipment within the gasholder comprised numerous small tools, waterproof outfits, two portable rafts, safety lines, rescue harnesses, boathooks, flameproof lamps, and white mice, while outside a resuscitation apparatus was always kept available. Throughout the whole of the work, the safety measures recommended by the Institution of Gas Engineers Gasholder Sub-Committee were enforced with the utmost stringency.

As soon as work commenced, it became evident that notwithstanding the measures taken to free the holder from oily vapours, the atmosphere was going to distress the men and retard progress. The greatest possible relief was given by the frequent release and replenishment of the air, and by providing gas-proof non-steaming goggles. Even so, frequent breaks had to be permitted. The work was done during the summer months, and the hot weather made matters worse by heating up the air in the holder.

The holder was raised until the cup of the inner lift was well clear of the water level in the tank. It was then possible for the men on the rafts to locate the leaks easily as the water from the cup dripped and in some parts streamed down inside the holder. Most of the leaks were situated at the cup carriages where the bolts had become slack and, in some cases, partially pulled through the plating due to the distortion caused by the frequent landing of the holder on the uneven layers of sludge, &c., on the rest blocks. Many rivets were found in the same condition. The renewal of the cup carriage bolts was a difficult matter owing to the semi-circular shape of the cup and the inaccessibility of two of the four bolts in each carriage. Various methods were tried—special spanners, drills, and drill stands were devised and eventually it was realized that the dip would have to be raised up from the bottom of the cup in order to get access to the bolt heads. The inner lift was therefore lowered until the bottom of the cup was about 6 in. below the edge of the dip plate of the second lift and a number of cast iron blocks were placed at regular intervals round the bottom of the cup. These blocks were actually old conveyor chain rollers, a sufficient quantity fortunately being available. The holder was again raised and with the dip of the second lift resting on the cast iron blocks in the cup of the inner lift there was now a space of about 4 in. between the edge of the dip plate and the bottom of the cup. A specially made spanner enabled the heads of the bolts to be held while the men inside unscrewed the nuts. Many bolts were removed in this manner, but others which could not be loosened had to be cut out with a cold set and heavy hammer.

The cutting out and replacement of these bolts was an extremely uncomfortable job for the men inside as the water was pouring down all the time. The average time taken to remove each of these bolts

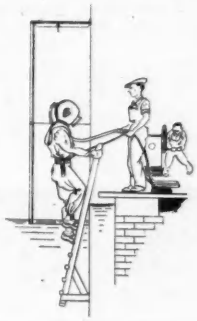


Fig. 4.
Divers access lute in side of holder

was about half an hour. Eventually all the bolts were cut out and replaced, leaking seams caulked and any loose rivets cut out and replaced with bolts. The cup was now tight and no leaks were to be found. The same procedure was carried out with the cups of the second and third lifts. In all, 676 bolts and 227 rivets were renewed under these unfavourable conditions.

While the above work was going on, the men outside were testing the outer surface of the dips with soapy water and caulking up any leaks. The guide carriages and rollers were also examined and where necessary the rollers removed and fitted with new pins and bushes.

After completing the repairs to the cups, &c., the timber framework for supporting the crown was examined and found to be in good condition. At some points the timber joints had become slack possibly due to shrinkage or warping, and repairs were carried out by fitting new bolts and packing pieces where required.

The holder was lowered on the completion of all inside work, and rafts, tools, platform, &c., dismantled and removed. The glass windows in the crown were taken off and replaced with steel sheets. The air lock was removed, the fan disconnected, and the purging machine again brought into use. The operations during the first period took five months to complete.

Repairs (Second Year)

The second part of the repair programme was to clear the sludge from the base of the tank and from the rest blocks, and complete any overhead work left over from the previous year. The preliminary preparations made on the previous occasion were repeated after purging and clearing out the purge gas with air. The holder was raised on air until the fourth lift was about half-way out of the water. Rectangular areas were marked off at six equidistant points on the shell plating. These areas were about 10 ft. deep by 3 ft. wide and arranged to accommodate internal lutes to allow the divers to enter the holder. Bolt holes were drilled down the sides and across the tops of the selected areas and temporarily plugged with wooden pegs. The pre-fabricated mild steel lutes, in sections, were passed down the side of the tank and pulled up on to the rafts inside by means of ropes and hooks. The lutes were assembled and bolted on to the areas arranged for them, the plugs being knocked out as the bolts were inserted. After the lutes had been attached to the shell plating, the holder was lowered until the bottom of the lute was sealed and an aperture cut through the steel plating, thus leaving an opening for the divers to enter. The holder was kept at a level which effectively sealed the lower and open ends of the lutes in the water. A short, strong, wooden ladder was fixed to the lower edge of each opening to enable the divers to enter the holder. (See Fig. 4 and photograph.)

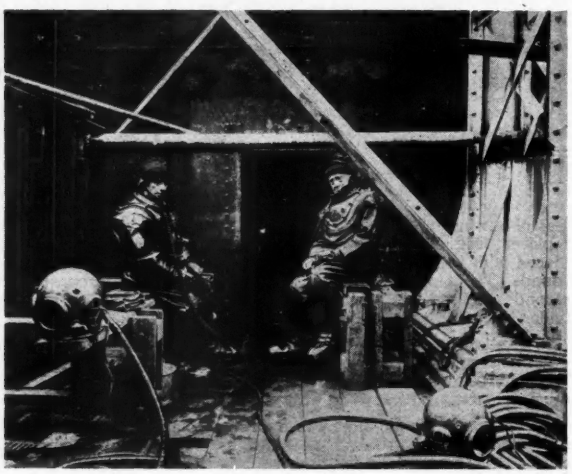
Preliminary explorations by the diver revealed that the debris was about 3 feet deep excepting on the rest blocks, where it had been consolidated by the weight of the lifts. The debris was also firmly packed in the 6 in. by 3½ in. tank guides.

Two sets of 5 in. suction, centrifugal, unchokeable pumps driven by 22 b.h.p. Diesel engines were employed, the divers handling the suction ends and disintegrating the compressed layers of debris with hand chisels. Great care had to be taken to prevent the choking of the suction hoses and pumps owing to the tendency of decayed vegetation to cling to the bores of the pipes and the pump impellors. The pumps, however, worked very satisfactorily and many old bolts and nuts were lifted and discharged with the debris. Compressed

air tools were provided for loosening the debris but were found unsuitable by the divers, and the introduction of high velocity water jets from a portable fire engine provided a satisfactory alternative. The water pressure had to be carefully adjusted to satisfy the divers' signals as they could offer little resistance to any unexpected thrust because of their buoyancy.

Some time elapsed before the intermittent work of the divers could be satisfactorily co-ordinated with that of the outside men who were responsible for moving the pumping equipment, removing and re-fixing the access lutes, &c. Nevertheless, towards the end of the job each diver was clearing 80 ft. of tank periphery per week. The circumference of the tank is 793 ft., and there are 52 rest blocks.

For the two divers, two sets of hand-operated air pumps were employed, requiring a total of eight men, four continuously on duty and four standing relief. Each diver had an assistant known as a "linesman" to send and receive signals by a prearranged system of pulls on the life-line fastened round the diver's waist. The divers stayed below for periods of two hours, and required short intervals of rest between the spells at work.



Divers at Access Lute

The sludge-laden water on passing through the pumps was delivered through piping with flexible joints to a specially constructed settling tank alongside the holder. This settling tank consisted of a primary tank and secondary settling beds. In the primary tank, which was a standard static water tank, the heavier portions of the sludge settled out. The main beds were 80 ft. long and 20 ft. broad and about 2 ft. deep with transverse divisions arranged so that the water overflowed from one compartment to the other on alternate sides of the cross division walls. It was designed so that one half of the tank could be cleaned out during the pumping operations. In practice, it was found that the tank could with advantage have been much larger to cope with the discharge of the two 5 in. pumps working at the same time. The whole tank was therefore used and the cleaning operations were done after the divers had stopped for the day. Additional surface baffles were found to be necessary to collect the debris which floated on the surface. The outlet of the settling tanks was connected to the holder tank through a 12 in. pipe, thus maintaining the water level in the gasholder tank.

During the pumping operations it is estimated that approximately 80 tons of dry material were removed and apart from the pump suctions occasionally getting blocked with leaves, very little trouble was experienced. The only pump damage was one broken impellor caused by sucking up an old paint scraper. During operations, articles not handled by the pumps but brought to the surface in light containers included two short railway sleepers, a set of rope blocks, an iron scaffold bracket, hammers, chisels, old boots and a pair of field glasses! This points to the necessity of having some form of guard or coping wall round gasholders where the top of the tank is at ground level.

To conclude the work, the special lutes were removed and the openings closed with steel sheets riveted in position. The holder was lowered and all tackle and plant removed. Measurements taken round the circumference of the holder established that the divers' work had been thorough and effective as the lifts were level on the rest blocks and the dips uniformly level with one another on the tank coping. The crown was purged of air as before and the holder put into commission. The operation during this repair period occupied 3½ months.

The repair work was carried out by our contractors, Messrs. Robert Dempster & Sons, Ltd., Elland, assisted by some of our own workmen, and was completed in a most effective manner. Much ingenuity was displayed by the members of their staff and operatives in tackling the job, in overcoming the difficulties, and in carrying out the work under most unpleasant and disagreeable conditions.

APPENDIX

Purging Operations

Reference has been made to the purging of the holder before and after repairs were carried out and the following is a brief description of the purging operations.

In past years when a gasholder was being closed down for internal inspection, repairs, or demolition, the methods used to clear the gas from the crown were somewhat crude. In most cases, live steam was injected at some convenient point and continued until an analysis of the escaping gases indicated that conditions were safe for workmen to enter the holder. When putting gas into the crown after repairs or when putting a new holder into commission, the gas was simply turned on and the air-gas mixture allowed to blow off to atmosphere until tests showed that all air had been expelled. From a safety point of view, these methods are most unsatisfactory, as there is a period of time during which a highly explosive mixture will be present in the holder and will only require a spark or a light from some external source to cause a serious explosion.

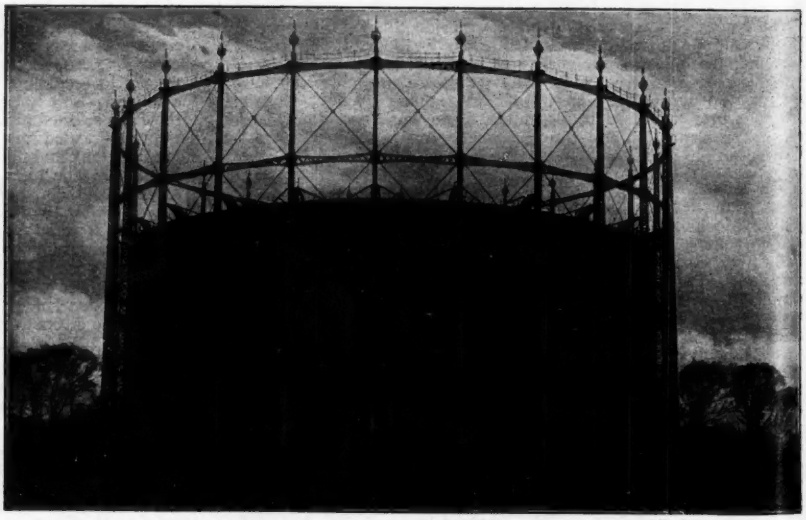
The modern and safe method of carrying out these operations is to use an inert gas from some suitable source. All danger of explosion was avoided by the use of a portable purging machine having a capacity of 10,000 cu.ft. inert gas per hour. The Harrison purging machine which was used was purchased early in the recent war for use in the event of damage by enemy action to gas plant, mains, &c. Fortunately it was not required for this purpose, but it has since been successfully used for purging gasholders, purifiers, mains, and other plant.

In the recent repairs, the purging machine was first of all used to clear the gas left in the crown, which amounted to approximately 425,000 cu.ft. The composition of this gas was as follows:

	%
Carbon dioxide	6.2
Heavy hydrocarbons	2.3
Oxygen	0.8
Carbon monoxide	18.0
Methane	16.0
Hydrogen	46.7
Nitrogen	10.0

The delivery pipe from the purging machine was connected to the gasholder inlet stand pipe. The gases from the crown escaped to atmosphere through valves on the top of the crown.

Purging was carried out for a continuous period of 105 hours, which meant that approximately 1.05 million cu.ft. of inert gas was passed into the holder crown. The average composition of the inert gas was 13% carbon dioxide and 1% oxygen.



General View of Gasholder

The recent paper by Mr. L. Silver* gave a method for calculating the explosive limits of a gas from its analysis. Applying this calculation to the foregoing analysis, the gas in the crown had a range of explosibility of 5.6% to 39.8%. He showed that in the case of a similar gas, the minimum added inert gas at the end of the purge should be 90% in passing from gas to air and 65% in passing from air to gas. Considering, then, the additional effect of diffusion on the purging process, he reached the conclusion that in a water sealed holder, 2 volumes of inert gas are required in replacing town gas by air, while in replacing air by town gas 1 to 2 volumes are required.

While purging was going on, regular analyses were made on the purge gas and on the gases issuing from the valves in the holder crown. The following table gives those results:

	Period of purging (hours)								
	20	25	37	43	50	61	67	76	81
	%	%	%	%	%	%	%	%	%
Carbon dioxide ...	7.3	7.9	9.2	10.1	11.8	12.1	11.5	12.1	13.7
Heavy hydrocarbons,	2.0	2.6	2.3	0.5	1.1	0.4	0.4	0.4	Nil
Oxygen	1.2	1.2	1.4	1.1	1.3	1.2	2.2	1.5	0.9
Carbon monoxide	15.3	13.0	17.6	4.4	3.7	2.5	2.2	1.8	Ni

The analyses, especially in the earlier period, showed some fluctuations in composition due, no doubt, to "pockets" of gas. At the 43rd hour of purging, the change in analysis was very marked and indicative of the piston effect of the heavy inert gas (sp.gr. 1.06) gradually forcing the town gas to the top of the crown and through the exit valves. It will be observed that at the end of 81 hours the crown had been completely purged with the use of approximately 0.81 million cu.ft. of inert gas. As a safety measure, purging was continued for a further 24 hours. The above results show that the quantity of inert gas used was approximately twice the amount of town gas to be displaced.

Mr. F. M. Birks† has stated that the most practicable method is to purge until the carbon dioxide content of the escaping gas is at least 91% of the sum of the mean carbon dioxide content of the purging gas (on an air free basis) and one-tenth of the carbon dioxide content of the gas initially in the holder. The purge gas on an air free basis contained 13.7% carbon dioxide and the gas in the holder at the commencement of operations 6.2% carbon dioxide, consequently the escaping gas at the end of the purge should have contained 0.91 (13.7 + 0.6) = 13% carbon dioxide. The final figure of 13.7% compared very closely with this. In addition to the samples drawn for analysis, frequent tests were made in a Hempel Explosion Burette, but no explosive mixture was obtained throughout.

On completion of the purging of the crown, the purging machine was turned over to air blowing with an output of 12,000 cu.ft. per hour. The air blowing was continued for a period of about 43 hours, which meant a quantity of about 0.52 million cu.ft. of air to displace the 0.425 million cu.ft. of purge gas. The purging machine was then connected up to the dips of the second, third, and fourth lifts to clear out the trapped gas and the usual tests were carried out and the purge gas removed by air blowing. The repair programme already described was then carried out.

On completion of the repairs and after all temporary openings on the holder had been closed up, the purging machine was again brought into use to clear out the air before admitting the town gas. The following tables show the composition of the exit gases during these operations:

Purging the air from holder crown					
Time	24 hr.	47 hr.	72 hr.	90 hr.	116 hr.
	%	%	%	%	%
Carbon dioxide	8.0	10.0	11.3	12.1	12.4
Oxygen	8.3	5.6	3.7	2.6	2.5

Admission of town gas to crown						
Time	24 hr.	46 hr.	52 hr.	70 hr.	75 hr.	99 hr.
	%	%	%	%	%	%
Carbon dioxide	9.2	8.1	7.5	7.4	7.4	6.8
Heavy hydrocarbons ...	1.4	1.8	1.9	1.8	1.7	2.3
Oxygen	1.7	1.2	1.7	1.1	1.3	1.0
Carbon monoxide	9.5	14.2	13.1	16.3	16.9	18.6

It will be observed that the time required to purge the air from the holder was 116 hours, which is much longer than the time required to purge the gas. This was no doubt due to the closer densities of the air and purge gas, and hence the piston effect was to a great extent lost. The volume of purge gas required to displace the air was in the ratio of 2½:1.

In practice, variations in times and volumes of purge gas required will depend greatly on the size of the holder and on the capacity of the purging machine, also on whether purging is carried out continuously from start to finish or intermittently as, for example, in the day time only. The whole subject of purging with inert gas has been extensively dealt with by Mr. F. M. Birks and Mr. L. Silver recently, and much valuable information and guidance can be obtained from a perusal of their excellent Papers.

* "The Purging of Gas Plant and Holders," by L. Silver, B.Sc., "GAS JOURNAL," Vol. 249, No. 4368.

† "Purging Gasholders by means of Inert Gas," by F. M. Birks, O.B.E., M.Inst.Gas E., Transactions of Institution of Gas Engineers, 1937-8, p. 405.

INSTITUTION OF GAS ENGINEERS

RESULTS OF 1947 EXAMINATIONS

THE undermentioned Candidates were successful in the 1947 Examinations in Gas Engineering (Manufacture) and Gas Engineering (Supply) of the Institution of Gas Engineers, held under the Education Regulations of the Institution.

EXTERNAL CANDIDATES (82)

Diploma in Gas Engineering (Manufacture) (10)

Class	Name	Undertaking
First	Grocott, F.	Birmingham
,,	Sanders, A. W.	Birmingham
Second	Benstead, T. W.	Clacton-on-Sea
,,	Canning, T. H.	Bromley-by-Bow, London
,,	Gallaher, P. E.	Birmingham
,,	Kinsey, R.	Salford
,,	Livingstone, T. B.	Perth
,,	Shortland, G.	Sunderland
,,	Sweeting, K. J.	Farnham
,,	Taylor, J. A.	Warrington

Higher Grade Certificate in Gas Engineering (Manufacture) 25)

Class	Name	Town
Second	Baker, D. A.	London
,,	Barrack, A. R.	Whitecairns
,,	Beale, E. W.	Birkenhead
,,	Carter, L. A.	Portsmouth
,,	Copsey, L.	Cheam
,,	Duxbury, A. D.	Leeds
,,	Hall, G.	Bristol
,,	Heeley, G. W.	Sittingbourne
,,	Henley, R. A. W.	Croydon
,,	Kershaw, J.	Darwen
,,	Martin, H.	Havant
,,	Middleton, G. J.	Lichfield
,,	Parker, F. P.	Portslade-by-Sea
,,	Piggott, K. L.	Stonehouse
,,	Pollard, R.	Kingston-on-Thames
,,	Pratt, A. G.	Ipswich
,,	Pursey, L. N. W.	Exmouth
,,	Randall, R. C.	Leamington Spa
,,	Silvey, G. A.	High Wycombe
,,	Smith, L. W.	London
,,	Smyth, C. S.	Aberdeen
,,	Stanford, L. F. H.	Hillingdon
,,	Twyman, C. E. G.	Margate
,,	Walshaw, A. E.	Bury
,,	Whitehead, C.	Middlesbrough

Ordinary Grade Certificate in Gas Engineering (Manufacture) 13)

Class	Name	Town
First	Holliss, G. J.	Weston-super-Mare
Second	Andrews, D. M.	Enfield
,,	Burgess, H. G.	Southampton
,,	Carter, G. P.	Weston-super-Mare
,,	Croxton, P. C. L.	Shrewsbury
,,	Fixke, H. W. M.	Bedford
,,	Godley, J. F. A.	Brighton
,,	Hayston, W.	Workington
,,	Holton, L. A.	Broadstairs
,,	Lockwood, H. T.	Southampton
,,	Powe, M. J.	Taunton
,,	Reeves, T. A.	Gerrards Cross
,,	Webb, G. N.	Felixstowe

Diploma in Gas Engineering (Supply) (1)

Class	Name	Undertaking
Second	Croad, G.	Sowerby Bridge

Higher Grade Certificate in Gas Engineering (Supply) (7)

Class	Name	Town
First	Cattlin, D. W.	Tonbridge
,,	Howell, W. F. S.	Marple
Second	Annakin, E.	Harrogate
,,	Burkett, E. C.	Harrogate
,,	Holden, R. A. J.	Brighton
,,	Hubbard, E. H.	London
,,	Tait, S. A.	South Stanley

Ordinary Grade Certificate in Gas Engineering (Supply) (17)

Class	Name	Town
First	Jones, R. S.	Stoke
,,	Partington, C. G.	Flixton
,,	Tammadge, A. A.	Worthing
,,	Woodcock, J.	Colwyn Bay
Second	Campbell, W. A.	Belfast
,,	Davies, P. D. J.	Plymouth
,,	Forbes, P. C.	Ware
,,	Keane, N. J.	Plymouth
,,	Kendall, C. R.	Leicester
,,	Kershaw, J.	Darwen
,,	Mark-Bell, G.	Carlisle
,,	Maunder, D. J.	Paignton
,,	May, V. E.	London
,,	Pearce, H. W. C.	Plymouth
,,	Wood, J.	Tenbury Wells
,,	Wragg, D. A.	Leeds
,,	Yates, H.	Chorley

Ordinary Grade (Single Subject) Examination in Gas Engineering (Supply) to qualify to sit for the Diploma in Gas Engineering (Manufacture) (9)

Class	Name	Town
First	Bowman, N. R.	Manchester
,,	Carpenter, T.	Hereford
,,	Clayfield, J. A.	Cirencester
,,	Crane, K. J.	Shrewsbury
,,	Gallaher, P. E.	Redditch
,,	*Grocott, F.	Birmingham
,,	*Messenger, E. I.	Workington
,,	Pawley, R. F. D.	Saltash
,,	Whitney, W. E.	Dudley

INTERNAL CANDIDATES (141)

Higher Grade Certificate in Gas Engineering (Manufacture) (27)

Class	Name	Town	Centre
First	Smith, R. B. J.	Bath	Bradford
,,	Parker, F.	Bradford	Bradford
,,	Bell, R. F.	—	Glasgow
Second	Bovill, F. A.	—	Newcastle-upon-Tyne
,,	Burton, J. W.	Northampton	Bradford
,,	Cameron, T. R.	—	Edinburgh
,,	Cobb, G.	Forfar	Bradford
,,	Cornock, J. S.	—	Glasgow
,,	Crewdson, S. A.	Wolverhampton	Bradford
,,	Crudgington, C. S.	—	Huddersfield
,,	Dalby, H. O.	London	Bradford
,,	Deeks, J. M.	Shanklin	Bradford
,,	Edwards, C. R.	—	Burnley
,,	Hargeaves, H.	—	Manchester
,,	Heap, R. B.	—	Burnley
,,	Herbert, K.	—	Manchester
,,	Holt, R. A.	Manchester	Bradford
,,	Laycock, D.	—	Bradford
,,	McIntyre, J.	—	Manchester
,,	Moseley, C. J.	—	Birmingham
,,	Mottershead, J. K.	—	Manchester
,,	Newall, R. J.	Runcorn	Bournemouth
,,	Oliver, F. B.	—	Edinburgh
,,	Philp, D.	—	Kirkcaldy
,,	Rawbone, J. W.	—	Derby
,,	Sawyer, F. W.	—	Huddersfield
,,	Slater, L.	—	Manchester

Ordinary Grade Certificate in Gas Engineering (Manufacture) (38)

Class	Name	Town	Centre
First	Egan, P. C.	—	Huddersfield
,,	Parry, H.	Holyhead	Brighton
,,	Sharpe, R. M.	Boston	Brighton
,,	Watson, J.	Dundee	Brighton
,,	Weston, R. G.	Chelmsford	Brighton
Second	Anderson, I. M.	—	Edinburgh
,,	Arbery, W. W.	—	Westminster
,,	Ashworth, J. C.	—	Halifax
,,	Barton, S.	Congleton	Brighton
,,	Bennett, R. W.	—	Leicester
,,	Briggs, E. B.	—	Manchester
,,	Buttery, H. V.	Birmingham	Brighton
,,	Clayton, D. F.	—	Birmingham
,,	Daniell, L. J.	London	Brighton
,,	Dean, A. W.	—	Bournemouth
,,	Glidden, R. C.	—	Birmingham
,,	Gough, G. A.	—	Birmingham
,,	Greenwood, D.	—	Halifax
,,	Heath, D. J.	Birmingham	Brighton
,,	Hendry, J.	—	Glasgow
,,	Hodgson, J.	—	Edinburgh
,,	Holt, A.	—	Huddersfield
,,	Jenkins, C.	—	Birmingham
,,	Jerman, D. R. S.	London	Brighton
,,	Johnston, W. McM.	—	Glasgow
,,	Kemp, G. H. C.	—	Westminster
,,	Kerr, A. G.	—	Glasgow
,,	Ridley, J. R.	—	Leicester
,,	Scott, J. E.	—	Edinburgh
,,	Shreeve, W. H.	Birmingham	Brighton
,,	Smith, J. W.	—	Edinburgh
,,	Smith, W. F.	—	Edinburgh
,,	Snow, F. N. P.	Birmingham	Brighton
,,	Spencer, A.	—	Birmingham
,,	Taylor, C. H.	—	Manchester
,,	Taylor, E.	—	Huddersfield
,,	Thomas, W. C.	—	Rotherham
,,	Tomkins, R. H. R.	Deal	Brighton

Higher Grade Certificate in Gas Engineering (Supply) (24)

Class	Name	Town	Centre
First	Elles, H. C.	Bristol	Bradford
Second	Abbott, H. S.	—	Westminster
,,	Ames, B. W.	Peterborough	Birmingham
,,	Andrews, J. O.	London	Bradford
,,	Bartram, R.	Sunderland	Bournemouth
,,	Brown, B. D.	Bristol	Bradford
,,	Bubb, S. H.	—	Birmingham
,,	Casson, L.	Halifax	Bradford
,,	Cummings, W.	—	Newcastle-upon-Tyne
,,	Cutlack, E. B.	—	Westminster
,,	Godley, J. F. A.	Brighton	Bradford
,,	Hanford, R. H.	Port Talbot	Bradford
,,	Hatch, A. W.	—	Bristol
,,	Jenks, F. R.	—	Birmingham
,,	Knowles, A. E.	—	Huddersfield
,,	Moorcroft, W.	Ormskirk	Bradford
,,	Moore, M. J.	Enfield	Birmingham
,,	Pintoff, G. I.	London	Bradford
,,	Pyle, J. N.	—	Westminster
,,	Rhodes, R. P.	—	Westminster
,,	Rodley, A.	—	Westminster
,,	Stanger, R. H.	—	Westminster
,,	Steel, J. E.	—	Westminster
,,	Wilson, N. D.	—	Manchester

Ordinary Grade Certificate in Gas Engineering (Supply) (50)

Class	Name	Town	Centre
First	Alcorn, J.	—	Glasgow
,,	Ball, R. F.	—	Glasgow
,,	Boys, H. W.	Brighton	Brighton
,,	Dewhirst, G. M.	Keighley	Brighton
,,	Emmony, R. O.	Nottingham	Brighton
,,	Hammond, D. H. P.	Brighton	Brighton
,,	Knight, B. R.	Brighton	Brighton
,,	Mason, A. D.	Haltwhistle	Brighton
,,	Parker, R. M.	—	Manchester
,,	Poynter, E.	—	Westminster
,,	Smith, J. W.	—	Edinburgh
,,	Thrupp, P. H.	Stourbridge	Brighton
,,	Totty, E. A.	—	Tunstall
,,	Vaughan, B.	—	Westminster
,,	*Hardy, A. L.	—	Westminster
,,	Hardy, F. J.	—	Westminster
,,	Jones, R.	—	Westminster
,,	Painter, F. E.	—	Westminster
,,	Rolls, E. H.	—	Westminster
,,	Tyler, P. W.	—	Westminster
,,	Williams, D. K.	—	Westminster
Second	Abraham, H. G.	—	Birmingham
,,	Anderson, I. M.	—	Edinburgh
,,	Birch, C. O.	—	Westminster
,,	Blacker, H. J.	Bristol	Brighton
,,	Bunker, P. J.	Brighton	Brighton
,,	Cormack, J. D.	—	Bournemouth
,,	Crossley, J.	—	Bradford
,,	Elsey, G. D. J.	—	Westminster
,,	Fitt, E. R. T.	—	Birmingham
,,	Forsyth, W.	—	Glasgow
,,	Hendry, J.	—	Glasgow
,,	Hodgson, J.	—	Edinburgh
,,	Kerr, A. G.	—	Glasgow
,,	Knight, F. E.	Barnstaple	Brighton
,,	MacLean, D. I.	—	Edinburgh
,,	Marsh, R.	Bromsgrove	Brighton
,,	Mitchell, W. S. G.	—	Birmingham
,,	Neves, W. C.	Brighton	Brighton
,,	O'Brien, J. B.	—	Bradford
,,	Owen, E. C.	—	Birmingham
,,	Raistrick, K.	—	Bradford
,,	Scott, J. E.	—	Edinburgh
,,	Smith, W. F.	—	Edinburgh
,,	Taylor, D. V.	Surbiton	Brighton
,,	Thomas, F. J.	—	Westminster
,,	Vale, A. J.	—	Huddersfield
,,	Watson, A. K.	—	Burnley
,,	Wilson, J. W.	Leeds	Brighton
,,	Woods, A. H.	Kettering	Brighton

Ordinary Grade (Single Subject) Examination in Gas Engineering (Supply) to qualify to sit for the Diploma in Gas Engineering (Manufacture) (2)

Class	Name	Centre
First	Barker, G. F. L.	Huddersfield
,,	Swinnerton, F. W.	Derby

The following candidates were successful in the "additional" examinations.

INTERNAL CANDIDATES (37)

Higher Grade Certificate in Gas Engineering (Manufacture) (8)

Class	Name	Town	Centre
First	Steed, L. G.	Stafford	Birmingham
,,	Waiton, H.	Morpeth	Birmingham
Second	Beilby, G. W.	Oldham	Birmingham
,,	Campbell, I.	Coatbridge	Birmingham
,,	Friggens, J. B.	Penzance	Birmingham
,,	Maplethorpe, K. E.	Grimsby	Birmingham
,,	Morris, J. E.	Alcester	Birmingham
,,	Welsh, J. H.	Birmingham	Birmingham

Ordinary Grade Certificate in Gas Engineering (Manufacture) (13)

Class	Name	Town	Centre
First	Dobson, W. E.	Coventry	Aston
,,	Edwards, K. R.	Exeter	Aston
,,	Gardner, C.	Farnworth	Aston
,,	*Hill, R. A.	Bournemouth	Aston
,,	Male, W. L.	Blyth	Aston
Second	Abraham, H. G.	Birmingham	Aston
,,	Capewell, F.	Birmingham	Aston
,,	Flux, D. T.	Shanklin	Aston
,,	Mann, C. P.	Derby	Aston
,,	Port, S.	Torquay	Aston
,,	Sweet, W. S.	Sunningdale	Aston
,,	White, L. F.	Aberystwyth	Aston
,,	Wood, M. S.	Birmingham	Aston

Higher Grade Certificate in Gas Engineering (Supply) (6)

Class	Name	Town	Centre
First	Perks, H. A.	Sutton Coldfield	Birmingham
,,	Watson, H. W.	Birmingham	Birmingham
,,	White, J. D.	Birmingham	Birmingham
Second	King, J. G.	London	Birmingham
,,	Owen, E. C.	Birmingham	Birmingham
,,	Parry, E. I.	Liverpool	Birmingham

Ordinary Grade Certificate in Gas Engineering (Supply) (10)

Class	Name	Town	Centre
First	Breeze, H.	Wallasey	Aston
,,	Coull, W.	Buckie	Aston
,,	Farr, E. W.	Coventry	Aston
,,	Lane, R. C.	Cannock	Aston
,,	Price, J.	Coventry	Aston
,,	Sharrock, R.	Prescot	Aston
Second	Cross, D.	Coventry	Aston
,,	Kirby, L. E.	Brighouse	Aston
,,	Wells, R.	London	Aston
,,	Williams, J. P.	Cardiff	Aston

*An asterisk against a candidate's name indicates that he has passed with distinction in the main subject.

SCIENTISTS AND TECHNICIANS FROM GERMANY

It was decided in December, 1945, as part of the general policy of securing industrial intelligence from Germany to bring to the United Kingdom a limited number of scientists and technicians drawn from those fields in which German science and technique was most advanced. All proposals for the employment of Germans under this scheme had to be sponsored by a Government Department and approved by an Interdepartmental Panel set up under the Chairmanship of Sir Charles Darwin.

Hitherto the scope of this scheme has been restricted to Germans who can make a scientific or technical contribution to industry which cannot be made by a British subject, and the knowledge gained from their work has been made freely available to the industry as a whole.

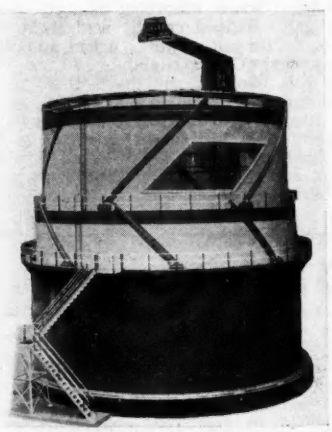
Within these strict limits a considerable amount of valuable knowledge has been secured and some progress has been made towards incorporating it in our industrial technique. Experience has, however, shown that if the exploitation of German scientific and technical knowledge it to be carried out to the fullest possible extent some provision must be made to enable those Germans whose exceptional ability and usefulness have been proved to be retained on a more permanent basis by firms willing and able to translate German ideas into production, and to permit, where necessary, the entry into the United Kingdom of production engineers and technicians having the specialized knowledge and experience required for the rapid development of the underlying idea. Further, as the capacity of Research Associations to take Germans and provide specialized equipment has already been largely satisfied, and as in some fields no Research Association exists, it is necessary to rely increasingly on private firms to obtain the maximum benefit from German ideas and knowledge.

Accordingly the scope of the Darwin Scheme has now been modified. As previously, only Germans who have a significant technical contribution to make to British industry and who are required to fill positions for which no British subjects are available will be admitted. They will all be volunteers and brought over initially under Government contracts and arrangements will be made wherever possible to give all potentially interested firms access to them. Subsequently, if the Darwin Panel consider it desirable for the German to be retained after the initial period of six months and employed by a particular firm, the German will be permitted to enter into a contract with the firm like any other alien entering the United Kingdom under a Ministry of Labour permit.

If the services of the best German scientists and technicians in the Gas Industry are to be obtained for this country it is important that applications for their services should be submitted as soon as possible. Other nations are anxious to obtain the services of these men, and delay in approaching them may mean they will not be available for British interests.

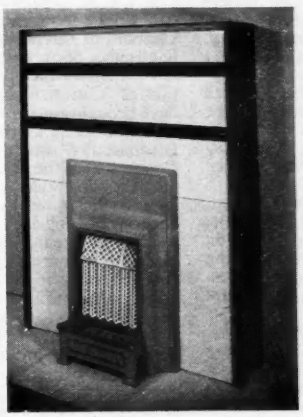
The Gas Research Board has been asked to make this matter known to its members, and any application from members can be relayed by the Director to the Department of Scientific and Industrial Research.

WORKING MODEL GASHOLDER



Our photograph shows a working model of the Oxley Engineering Company's welded spirally-guided gasholder which has been on exhibition in this country. It is believed to be the first working model of a spirally-guided holder to be made, and is fitted with windows which permit the interior to be examined during working operation. The structure over the holder carries the automatic operating gear for inflating and deflating the lifts, and the working of the patent overflow and return ducts can be observed. An important feature of the model is that the water can be clearly seen being returned from the tank to the cup during the process of uncupping the lifts, thereby giving the extra seal to prevent gas blowing.

THE GAS "SUPAHEETA"



We have had brought to our notice by the makers, Universal Utilities, 28a-34, Oxford Road, Manchester 1, a new unit—named the "Supaheeta"—for use with gas fires. This unit, constructed of aluminium with a cellulose stoved enamel finish, is designed for utilizing the products of combustion after they leave the fire. It consists of a box into which the products of combustion from the gas fire are emitted, and by arrangements of special baffles heat is drawn off and the remaining heat and combustion products go thence to the flue. No products enter the room. The device is so designed that the flue temperature can be kept above condensation point, and the back pressure to an absolute minimum and passing approved tests for the removal of combustion products.

ACTIVITIES AT COVENTRY

Coventry is the third place to have the exhibition in connexion with the launching of Ascot Gas Water Heaters, Ltd.'s new publication "Houses Into Flats." Our photograph shows, in addition to the impressive conversion display (left to right):—Alderman Howatt (Chairman of Gas Committee); Mr. F. P. S. Stammers (Director, Ascot Gas Water Heaters, Ltd.); Alderman Briggs (Mayor of Coventry); Mr. D. E. E. Gibson (City Architect, Coventry); Mr. J. E. Wakeford (Engineer and Manager, Coventry Gas Department) and Mr. R. J. Gregg (Sales Manager, Ascot Gas Water Heaters, Ltd.)

The display studios of the City of Coventry Gas Department are responsible for posters placed at each end of the trench excavation on the link-up main road from Coventry to Birmingham. The slogan on the reverse side of the board is, "Mr. Therm is coming to serve YOU."